# embedded 4.3" TFT-DISPLAY 480x272 BUILT-IN INTELLIGENCE



Dimensions 107x71x12mm

- \* TET GRAPHIC DISPLAY WITH BULIT-IN GRAPHIC FUNCTIONS
- \* 480x272 DOTS, 16-BIT (65,536) COLORS WITH LED BACKLIGHT
- \* LANDSCAPE AND PORTRAIT MODE (272x480) BY COMMAND
- \* 4MB ON BOARD FLASH FOR FONTS, PICTURES, ANIMATIONS AND MACROS
- \* POWER SUPPLY +5V / 180mA
- \* 8 PRE-DEFINED FONTS, CAN BE EXPANDED
- \* FONT ZOOM FROM 2mm TO about 80mm, TURNABLE IN 90° STEPS
- \* 3 DIFFERENT INTERFACES ON BOARD: RS-232, I2C-BUS OR SPI-BUS
- \* POSITIONING ACCURATE TO THE PIXEL WITH ALL FUNCTIONS
- \* DRAW LINE, PLACE A DOT, AREA, BARGRAPH...
- \* PICTURES AND ANIMATIONS
- \* MIX TEXT AND GRAPHIC
- \* MULTI-LINGUAL WITH MACRO PAGES
- \* BACKLIGHT BRIGHTNESS BY SOFTWARE
- \* ANALOGUE TOUCH PANEL: VARIABLE GRID
- \* FREE DEFINABLE KEY AND SWITCH
- \* 8 DIGITAL IN- AND 8 DIGITAL OUTPUT
- \* 2 ANALOGUE INPUTS COMFORTABLE TO USE

### **ORDERING CODES**

### **DISPLAYS**

TFT 480x272 DOTS, WHITE LED BACKLIGHT AS ABOVE, BUT WITH TOUCH PANEL STARTERKIT

INCLUDES EA eDIPTFT43-ATP AND EVALUATION BOARD WITH USB FOR DIRECT CONNECTION TO PC AND INTERFACE BOARDS FOR CONNECTION WITH YOUR HOST SYSTEM ADDTIOTNAL PARTS

MOUNTING BEZEL (ALUMINIUM), BLACK ANODIZED SOCKET 1x20, 4.5mm HIGH (1 piece)

EA eDIPTFT43-A
EA eDIPTFT43-ATP

**EA EVALeDIPTFT43** 

EA 0FP481-43SW EA B254-20



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	Documentation of revision													
Date	Туре	Old	New	Reason / Description										
July, 22nd. 2008	1.0			1st. Edition										
March 2009	1.1		- additional command: ESC YD, ESC VM, ESC YX - bug fix											
June 2009	1.2		- additional command: ESC ZB - bug fix											
November 2009	1.3		- bug fix "bargraph" and "clear touch"											
May 2011	1.4		- additional functions: Instruments, extended Ports											
January 2012	1.5		- additonal functions: X/Y-graph, String table											

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### **GENERAL**

The EA eDIP series of displays are the world's first displays with integrated intelligence. In addition to a variety of integrated fonts that can be used with pixel accuracy, they offer a whole range of sophisticated graphics functions.

The displays are ready for operation immediately with an operating voltage of 5V. They are controlled via one of the 3 integrated interfaces: RS-232, SPI or I<sup>2</sup>C. The displays are "programmed" by means of high-level language-type graphics commands. There is no longer any need for the time-consuming programming of character sets and graphics routines. The ease of use of this display with its touch panel dramatically reduces development times.

### **HARDWARE**

The display is designed to work at an operating voltage of +5V. Data transfer is either serial and asynchronous in RS-232 format or synchronous via the SPI or I<sup>2</sup>C specification. To improve data security, a simple protocol is used for all types of transfer.

### **ANALOG TOUCH PANEL**

All versions are also available with an integrated touch panel: You can make entries and menu or bar graph settings by touching the display. The labeling of the "keys" is flexible and can also be changed during runtime (different languages, icons). The drawing of the individual "keys" and the labeling is handled by the integrated software.

### LED ILLUMINATION

All displays are equipped with modern, energy-saving LED illumination. Brightness can be varied 0~100% by command.

In 24-hour operation, the illumination should be dimmed or switched off as often as possible to increase their lifetime.

### SOFTWARE

This display is programmed by means of commands, such as *Draw a rectangle from* (0,0) to (479,271). No additional software or drivers are required. Strings and images can be placed with **pixel accuracy**. Text and graphics can be combined at any time. Different character sets can be used at same time. Each character set and the images can be zoomed from 2 to 8 times and rotated in 90° steps. With the largest character set, the words and numbers displayed will fill the screen.

### **ACCESSORIES**

Evaluation-Board (Programmer) for internal data flash memory

The display is shipped fully programmed and with all fonts. The additional Evaluation-Board is thus generally not required.

However, if the internal character sets have to be changed or extended, or if images or macros have to be stored internally, the Evaluation-Board EA 9777-2USB, which is available as an accessory, will burn the data/images you have created into the on-board data flash memory (4 MB) permanently.

The Evaluation-Board runs under Windows and is connected to the PC's USB interface. It is shipped with an interface cable and the installation software. The Evaluation-Board is equipped with serveral LEDs, pushbottons and potentiometer to test all peripherial modes of the eDIP.

<u>Interface-Expansion for Evaluation-Board (included in the Starter-Kit):</u>

Wtih the expansion EA 9777-2PE for the Evaluation-Board all interfaces of the display are made available with the help from small adapter boards: RS-232, RS-485, SPI, I<sup>2</sup>C, RS-232 (CMOS level). Further information you will find in the datasheet of the Evalution-Board.



### **RS-232 INTERFACE**

If the display is wired as shown below, the RS-232 interface is selected. The pin assignment is specified in the table on the right.

The RxD and TxD lines lead 5V (CMOS level) to a microcontroller, for example, for direct connection.

If "genuine" RS-232 levels are required (e.g. for connection to a PC), an external level converter (e.g. MAX232) is required.

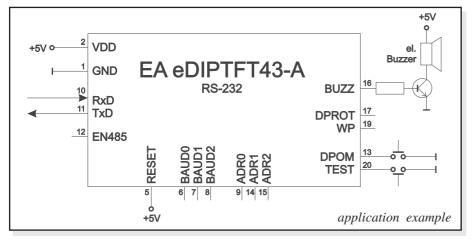
			Pinout eDIPTFT43-A: R	S-2	232/	RS-485 mod	le	
Pin	Symbol	In/Out	Function		Pin	Symbol	In/Out	Function
1	GND		Ground Potential for logic (0V)		21	GND		Ground (0V)
2	VDD		Power supply for logic (+5V)		22	VDD		Power supply (+5V)
3	NC		do not connect		23	AIN1	In	analogue input 05V
4	NC		do not connect		24	AIN2	] "	DC impedance 1MOhm
5	RESET	ln	L: Reset		25	OUT1 / MO8		8 digital outputs
6	BAUD0	In	Baud Rate 0		26	OUT2 / MO7		maximum current:
7	BAUD1	In	Baud Rate 1		27	OUT3 / MO6		IOL = IOH = 10mA
8	BAUD2	In	Baud Rate 2		28	OUT4 / MO5	Out	alternativ un te 0 metriv
9	ADR0	In	Address 0 for RS-485		29	OUT5 / MO4	Out	alternativ up to 8 matrix keyboard output lines
10	RxD	In	Receive Data		30	OUT6 / MO3		(reduces the digital
11	TxD	Out	Transmit Data		31	OUT7 / MO2		output lines, see chapter
12	EN485	Out	Transmit Enable for RS-485 driver		32	OUT8 / MO1		external keyboard)
13	DPOM	In	L: disable PowerOnMacro do not connect for normal operation		33	IN1 / MI8		
14	ADR1	In	Address 1 for RS-485		34	IN2 / MI7		8 digital inputs
15	ADR2	In	Address 2 for RS-485		35	IN3 / MI6		open-drain with internal
16	BUZZ	Out	Buzzer output		36	IN4 / MI5		pullup 2050k
17	DPROT		L: Disable Smallprotokoll do not connect for normal operation		37	IN5 / MI4	In	alternativ up to 8 matrix keyboard input lines
18	DNC	Out	L: internal, do not connect		38	IN6 / MI3		(reduces the digital input
19	WP	In	L: Writeprotect for DataFlash	]	39	IN7 / MI2		lines, see chapter
20	TEST SBUF	Out	open-drain with internal pullup 2050k IN (Power-On) L: Testmode OUT L: data in sendbuffer		40	IN8 / MI1		external keyboard)

### **BAUD RATES**

The baud rate is set by means of pins 6, 7 and 8 (baud 0 to 2). The data format is set permanently to 8 data bits, 1 stop bit, no parity.

RTS/CTS handshake lines are not required. The required control is taken over by the integrated software protocol (see pages 10 and 11).

Baud Rates           Baud0         Baud1         Baud2         data format 8,N,1           1         0         0         2400           0         1         0         4800           1         1         0         9600           0         0         1         19200           1         0         1         38400										
Baud0	Baud1	Baud2								
1	0	0	2400							
0	1	0	4800							
1	1	0	9600							
0	0	1	19200							
1	0	1	38400							
0	1	1	57600							
1	1	1	115200							
0	0	0	230400							



#### Note:

The pins BAUD 0 to 2, ADR 0 to 2, DPOM, DPROT and TEST/SBUF have an internal pullup, which is why only the LO level (0=GND) is to be actively applied. These pins must be left open for a Hi level. For RS232 operation (without addressing) the pins ADR 0 to ADR 2 must be left open.

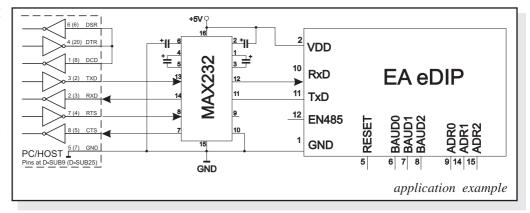
On pin 20 (SBUF) the display indicates with a low level that data is ready to be retrieved from the internal send buffer. The line can be connected to an interrupt input of the host system, for example.



### APPLICATION EXAMPLE "REAL" RS-232 INTERFACE

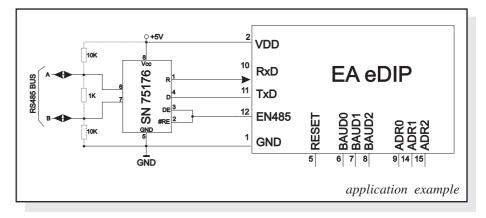
The eDIP fits for direct connection to a RS-232 interface with CMOS level (VDD).

If you have an interface with ±12V level, an external levelshifter is needed



### **APPLICATION EXAMPLE: RS-485 INTERFACE**

With an external converter (e.g. SN75176), the EA eDIP can be connected to a 2-wire RS-485 bus. Large distances of up to 1200 m can thus be implemented (remote display). Several EA eDIP displays can be operated on a single RS-485 bus by setting addresses.

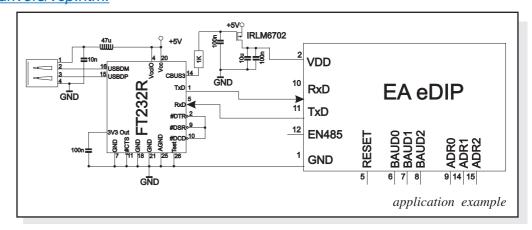


### Addressing:

- Up to eight hardware addresses (0 to 7) can be set by means of Pins ADR0..ADR2
- The eDIP with the address 7 is selected and ready to receive after power-on.
- The eDIPS with the addresses 0 to 6 are deselcted after power-on
- Up to 246 further software addresses can be set by means of the '#KA adr' command in the power-on macro (set eDIP externally to address 0)

### **APPLICATION EXAMPLE: USB INTERFACE**

With an external converter (e.g. FT232R) from FTDI the eDIP can be connected to an USB-Bus. Virtual-COM-Port drivers are available for different Systems on the FTDI Homepage: <a href="http://www.ftdichip.com/drivers/vcp.htm">http://www.ftdichip.com/drivers/vcp.htm</a>.





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### SPI INTERFACE

If the display is wired as shown below, SPI mode is activated. The data is then transferred via the serial, synchronous SPI interface.

The transfer parameter will be set via the pins DORD, CPOL and CPHA.

			Pinout eDIPTFT43	3-A	: SF	Pl mode		
Pin	Symbol	In/Out	Function		Pin	Symbol	In/Out	Function
1	GND		Ground Potential for logic (0V)		21	GND		Ground (0V)
2	VDD		Power supply for logic (+5V)		22	VDD		Power supply (+5V)
3	NC		do not connect		23	AIN1	In	analogue input 05V
4	NC		do not connect		24	AIN2	- 111	DC impedance 1MOhm
5	RESET	In	L: Reset		25	OUT1 / MO8		8 digital outputs
6	SS	In	Slave Select		26	OUT2 / MO7		maximum current:
7	MOSI	In	Serial In		27	OUT3 / MO6		IOL = IOH = 10mA
8	MISO	Out	Serial Out		28	OUT4 / MO5	Out	alternativ up to 8 matrix
9	CLK	In	Shift Clock		29	OUT5 / MO4	Out	keyboard output lines
10	DORD	In	Data Order (0=MSB first; 1=LSB first)		30	OUT6 / MO3		(reduces the digital
11	SPIMO	In	connect to GND for SPI interface		31	OUT7 / MO2		output lines, see chapter
12	NC		do not connect		32	OUT8 / MO1		external keyboard)
13	DPOM	ln	L: disable PowerOnMacro do not connect for normal operation		33	IN1 / MI8		
14	CPOL	In	Clock Polarity (0=LO 1=HI when idle)		34	IN2 / MI7		8 digital inputs
15	CPHA	In	Clock Phase sample 0=1st;1=2nd edge		35	IN3 / MI6		open-drain with internal
16	BUZZ	Out	Buzzer output		36	IN4 / MI5		pullup 2050k
17	DPROT	In	L: Disable Smallprotokoll do not connect for normal operation		37	IN5 / MI4	In	alternativ up to 8 matrix keyboard input lines
18	DNC	Out	L: internal, do not connect		38	IN6 / MI3		(reduces the digital input
19	WP	In	L: Writeprotect for DataFlash		39	IN7 / MI2		lines, see chapter
20	TEST SBUF	IN Out	open-drain with internal pullup 2050k IN (Power-On) L: Testmode OUT L: data in sendbuffer		40	IN8 / MI1		external keyboard)

#### *Note:*

The pins DORD, CPOL, CPHA, DPOM, DPROT and TEST/SBUF have an internal pullup, which is why only the LO level (0=GND) is to be actively applied. These pins must be left open for a Hi level.

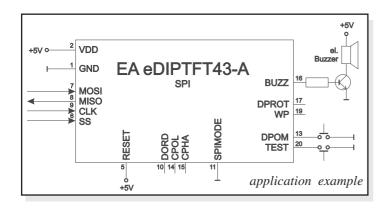
On pin 20 (SBUF) the display indicates with a low level that data is ready to be retrieved from the internal send buffer. The line can be connected to an interrupt input of the host system, for example.

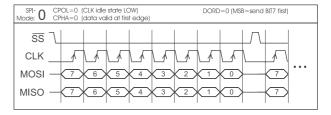
### **DATA TRANSFER SPI**

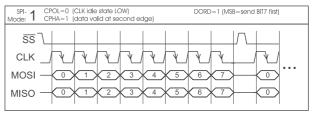
Write operation: a clock rate up to 200 kHz is allowed without any stop. Together with a pause of 100  $\mu$ s between every data byte a clock rate up to 3 MHz can be reached.

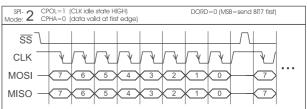
Read operation: to read data (e.g. the "ACK" byte) a dummy byte (e.g. 0xFF) need to be sent.

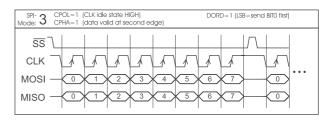
Note that the EA eDIP for internal operation does need a short time before providing the data; therefore a short pause of min.  $6\mu s$  (no activity of CLK line) is needed for each byte.













### **I<sup>2</sup>C-BUS INTERFACE**

If the display is wired as shown below, it can be operated directly on an I<sup>2</sup>C bus.

8 different base addresses and 8 slave addresses can be selected on the display.

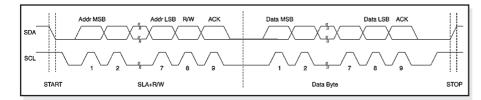
Data transfer is possible at up to 100 kHz. However, if pauses of at least 100  $\mu s$  are maintained between the individual bytes during transfer, a byte can be transferred at up to 400 kHz.

			Pinout eDIPTFT43	3-A	: 12	C mode		
Pin	Symbol	In/Out	Function		Pin	Symbol	In/Out	Function
1	GND		Ground Potential for logic (0V)		21	GND		Ground (0V)
2	VDD		Power supply for logic (+5V)		22	VDD		Power supply (+5V)
3	NC		do not connect		23	AIN1	In	analogue input 05V
4	NC		do not connect		24	AIN2	""	DC impedance 1MOhm
5	RESET	ln	L: Reset		25	OUT1 / MO8		8 digital outputs
6	BA0	In	Basic Address 0		26	OUT2 / MO7		maximum current:
7	BA1	In	Basic Address 1		27	OUT3 / MO6		IOL = IOH = 10mA
8	SA0	ln	Slave Address 0		28	OUT4 / MO5	Out	alternativ up to 8 matrix
9	SA1	ln	Slave Address 1		29	OUT5 / MO4	Out	keyboard output lines
10	SA2	In	Slave Address 2	]	30	OUT6 / MO3		(reduces the digital
11	BA2	In	Basic Address 2	]	31	OUT7 / MO2		output lines, see chapter
12	I2CMO	In	connect to GND for I <sup>2</sup> C interface	]	32	OUT8 / MO1		external keyboard)
13	DPOM	In	L: disable PowerOnMacro do not connect for normal operation		33	IN1 / MI8		
14	SDA	Bidir.	Serial Data Line		34	IN2 / MI7		8 digital inputs
15	SCL	In	Serial Clock Line		35	IN3 / MI6		open-drain with internal
16	BUZZ	Out	Buzzer output		36	IN4 / MI5		pullup 2050k
17	DPROT	In	L: Disable Smallprotokoll do not connect for normal operation		37	IN5 / MI4	In	alternativ up to 8 matrix keyboard input lines
18	DNC	Out	L: internal, do not connect		38	IN6 / MI3		(reduces the digital input
19	WP	In	L: Writeprotect for DataFlash		39	IN7 / MI2		lines, see chapter
20	TEST SBUF	IN Out	open-drain with internal pullup 2050k IN (Power-On) L: Testmode OUT L: data in sendbuffer		40	IN8 / MI1		external keyboard)

### Note:

The pins BA0 to 2, SA0 to 2, DPOM, DPROT and TEST/SBUF have an internal pullup, which is why only the LO level (L=0=GND) is to be actively applied. These pins must be left open for a Hi level (H=1).

On pin 20 (SBUF) the display indicates with a low level that data is ready to be retrieved from the internal send buffer. The line can be connected to an interrupt input of the host system, for example.



	I <sup>2</sup> C - Address													
	n 11,		Base		I <sup>2</sup> C address									
BA2	BA1	BA0	address		D7	D6	D5	D4	D3	D2	D1	D0		
L	L	L	\$10		0	0	0	1						
L	L	Н	\$20		0	0	1	0						
L	Н	L	\$30		0	0	1	1	_		_			
L	Н	Н	\$40		0	1	0	0	S	S	S	R		
Ξ	L	L	\$70		0	1	1	1	2	1	0	W		
Н	L	Н	\$90		1	0	0	1	-					
Н	Н	L	\$B0		1	0	1	1						
Н	Н	Н	\$D0		1	1	0	1						

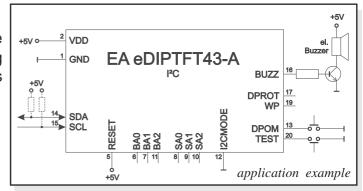
all pins open: Write \$DE Read \$DF

### **DATA TRANSFER I2C-BUS**

principle I2C-bus transfer:

- I<sup>2</sup>C-Start
- Master-Transmit: EA eDIP-I<sup>2</sup>C-address (e.g. \$DE), send smallprotocol package (data)
- I<sup>2</sup>C-Stop
- I2C-Start
- Master-Read: EA eDIP-I<sup>2</sup>C-Address (e.g. \$DF), read ACK-byte and opt. smallprotocoll package (data)
- I<sup>2</sup>C-Stop

Read operation: for internal operation the EA eDIP does need a short time before providing the data; therefore a short pause of min. 6μs is needed for each byte (no activity of SCL line).





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### **ANALOGUE INPUT AIN1 AND AIN2** (PIN 23+24)

For analogue measurement 2 inputs with a range of 0..VDD are available. Each input is grounded (GND) and DC impedance is  $1M\Omega$ . Please make sure that only positive voltages will be supplied there. Internal resolution is 10 Bit, equal to a 3-digit DVM modul. Linearity (after adjustment) is around 0.5%.

### Adjustment

Analogue inputs are not calibrated when shipped out. A procedure for adjustment may be like that:

- 1.) Put a well known voltage within a range of 2-VDD to analogue input (example: 3,0V, AIN1)
- 2.) Run command for calibration (see page 16). Example: "ESC V @ 1 3000".

Each input query can be done via serial interface or directly shown on display (as digits or bargraph in various colors and sizes).

Best way for direct visualisation are Process-macros or one of Analogue-macros (e.g. starting at every voltage change, or above/below a limit).

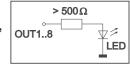
Both input lines are scaleable from 0 to  $\pm 9999.9$ . Scaling will be done via definition at 2 voltages "value1=string1;value2=string2" (see table on page 16).

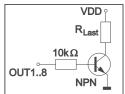
### **DIGITAL INPUT AND OUTPUT**

The EA eDIP is featured with 8 digital input and 8 digital output lines (CMOS level, grounded).

### 8 outputs (Pin 25-32)

Each line can be controlled individually using the "ESC Y W" command. A maximum current of 10mA can be switched per line. This give the opportunity to drive a low power LED in direct way. To source higher current please use an external transistor.





### 8 inputs (Pin 33-40)

Each input provides an internal 20..50 k $\Omega$  pull-up resistor, so it is possible to connect a key or switch directly between input and GND. The inputs can be queried and evaluated directly via the serial interface ("ESC Y R").



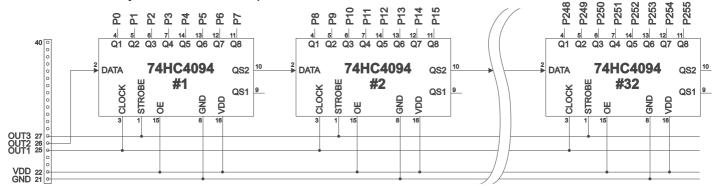
In addition to that every port change may start an individual port - or bit-macro (see p. 28).

The command "ESC Y A 1" activates automatic port query. Every alteration of inputs firstly calls bit macros and afterwards port macros. If there is no definied macro, the new status is transferred into the send buffer (refer to p. 19).

Note: The logic circuitry is designed for slow operations; in other words, more than 3 changes per second cannot be easily executed.

### **EXTENDED OUTPUTS (V1.4 AND HIGHER)**

It is possible to connect 1 to 32 chips like 74HC4094 to the eDIP (OUT1...OUT3), this is why it is attainable to have 8 to 256 additional outputs. The command "ESC Y E n1 n2 n3" (see p. 17) provides a comfortable way to control the outputs.





### EXTERNAL KEYBOARD

A keyboard (anything from individual keys to a 8x8 matrix keyboard) can be connected to the I/O-ports. The command 'ESC Y M n1 n2 n3' defines the count of input lines (n1=1..8) and output lines (n2=1..8). n3 set debounce function with 10ms steps (n3=0..15). Please note that count of digital input and output lines will be reduced while connecting an external keyboard at the same port.

Each key is connected with 1 output and 1 input. All inputs are terminated with a 20..50k $\Omega$  pull-up resistor. For double-keytroke function decoupling of outputs is necessary. For that please use schottky diodes (e.g. BAT 46).

### <u>Transmitting the keystrokes</u>

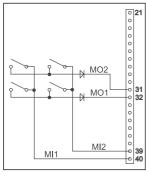
At each keystroke, the associated key number (1..64) is transmitted or - if a corresponding Matrix-Macro is defined, Matrix-Macro will be started. The release of the key is not transmitted. If the release of the key is to be transmitted as well, this can be done by defining Matrix-Macro no. 0. (see page 19: Responses of EA eDIPTFT43-A)

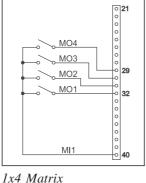
### Calculation of key numbers:

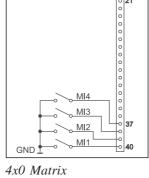
**Key\_number = (output-1) \* count\_of\_inputs + input** (output = MOx, input = MIx).

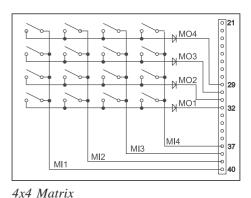
### **Examples**

- 2x2 matrix: Command 'ESCY M 2 2 ...' defines the 2x2 matrix. Keypad will need input lines MI1, MI2 and output lines MO1, MO2. Output lines are decoupled by diodes; this is for double keystrokes necessary. 6 input and 6 output lines remain free for other requirements.
- 1x4 matrix: Command 'ESC Y M 1 4 ..' defines the 1x4 matrix. Keypad will need output lines MO1..MO4 and a single input line MI1. With that connection 7 input and 4 output lines remain free for other requirements.
- 4x0 matrix: Using one single output only (physically 4x1 Matrix), all keys can switch to GND. So no output line is necessary and comman 'ESC Y M 40..' defines 4 input lines onyl. With that connection 4 input and 8 output lines remain free for other requirements.
- 4x4 matrix: Command 'ESCY M 4 4 ..' defines the 4x4 matrix. Keypad will need input lines MI1..MI4 and output lines MO1..MO4. Output lines are decoupled by diodes; this is for double keystrokes necessary. 4 input and 4 output lines remain free for other requirements.









2x2 Matrix

START

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### DATA TRANSFER PROTOCOL (SMALL PROTOCOL)

The protocol has an identical structure for all 3 interface types: RS-232, SPI and I<sup>2</sup>C. Each data transfer is embedded in a fixed frame with a checksum (protocol package). The EA eDIPTFT43-A acknowledges this package with the character <ACK> (=\$06) on successful receipt or <NAK> (=\$15) in the event of an incorrect checksum or receive buffer overflow. In the case of <NAK>, the entire package is rejected and must be sent again.

Receiving the <ACK> byte means only that the protocol package is ok, there is no syntax check for the command.

Note: it is neccessary to read the <ACK> byte in any case.

If the host computer does not receive an acknowledgment, at least one byte is lost. In this case, the set timeout has to elapse before the package is sent again.

The raw data volume per package is limited to 255 bytes (len <= 255). Commands longer than 255 bytes (e.g. Load image ESC UL...) must be divided up between a number of packages. All data in the packages are compiled again after being correctly received by the EA eDIPTFT43-A.

### DEACTIVATING THE SMALL PROTOCOL

For tests the protocol can be switched off with an L level at pin 17 = DPROT. In normal operation, however, you are urgently advised to activate the protocol. If you do not, any overflow of the receive buffer will not be detected.

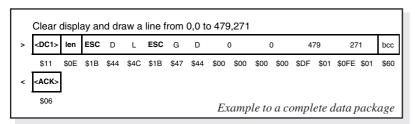
### WRITE <DC1> len data... bcc wait wait >6us (SPI only) t = timeout **READ** no answer (1 byte) NAK (\$15) ≠ NAK **BYTE** ≠ ACK ACK (\$06) **END**

### **BUILDING THE SMALLPROTOCOL PACKAGES**

Command/Data to the display

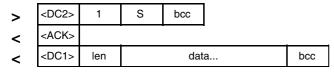


<DCI> = 17(dec.) = \$11 <ACK> = 6(dec.) = \$06  $len = count\ of\ user\ data\ (without\ <DCI>,\ without\ checksum\ bcc)$  $bcc = 1\ byte = sum\ of\ all\ bytes\ incl.\ <DCI>\ and\ len,\ modulo\ 256$ 



The user data is transferred framed by <DC1>, the number of bytes (len) and the checksum (bcc). The display responds with <ACK>.

### Request for content of send buffer



< DC2 > = 18(dec.) = \$12 I = I(dez.) = \$01 S = 83(dez.) = \$53 < ACK > = 6(dec.) = \$06

len = count of user data (without <DC2>, without checksum bcc) bcc = 1 byte = sum of all bytes incl. <DC2>, modulo 256 The command sequence <DC2>, 1, S, bcc empties the display's send buffer. The display replies with the acknowledgement <ACK> and the begins to send all the collected data such as touch keystrokes.



### Request for buffer information

>	<dc2></dc2>	1	I	bcc		
<	<ack></ack>				•	
<	<dc2></dc2>	2	send bytes		receive buffer bytes free	bcc

< DC2 > = 18(dec.) = \$12 1 = 1(dez.) = \$01 I = 73(dez.) = \$49 < ACK > = 6(dec.) = \$06

send buffer bytes ready = count of bytes stored in send buffer receive buffer bytes free = count of bytes for free receive buffer bcc = 1 byte = sum of all bytes incl. <DC2>, modulo 256

This command queries whether user data is ready to be picked up an how full the display's receive buffer is.

### Protocol settings

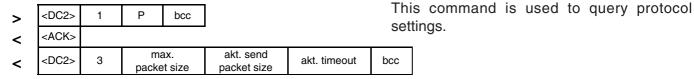
>	<dc2></dc2>	3	D	packet size for send buffer	timeout	bcc
<	<ack></ack>					

<DC2> = 18(dec.) = \$12 3 = 3(dez.) = \$03 D = 68(dez.) = \$44 packet size for send buffer = 1..128 (standard: 128) timeout = 1..255 in 1/100 seconds (standard: 200 = 2 seconds) bcc = 1 byte = sum of all bytes incl. <DC2>, modulo 256 <ACK> = 6(dec.) = \$06

This is how the maximum package size that can be sent by the display can be limited. The default setting is a package size with up to 128 bytes of user data.

The timeout can be set in increments of 1/100 seconds. The timeout is activated when individual bytes get lost. The entire package then has to be sent again.

### Request for protocol settings



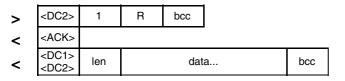
<DC2> = 18(dec.) = \$12 I = I(dez.) = \$01 P = 80(dez.) = \$50<ACK> = 6(dec.) = \$06

max. packet size = count of maximum user data for 1 package (eDIPTFT43-A = 255) akt. send packet size = current package size for send

akt. timeout = current timeout in 1/100 seconds

bcc = 1 byte = sum of all bytes incl. <DC2>, modulo 256

### Repeat the last package



< DC2 > = 18(dec.) = \$12 1 = 1(dez.) = \$01 R = 82(dez.) = \$52

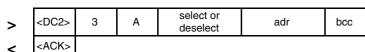
 $<\!\!ACK\!\!>\ =6(dec.)=\$06$ 

< DC1 > = 17(dec.) = \$11

 $len = count\ of\ user\ data\ in\ byte\ (without\ ckecksum,\ without\ <\!DC1\!>\ or\ <\!DC2\!>)$ 

 $bcc = 1 \ byte = sum \ of \ all \ bytes \ incl. < DC2 > and \ len, \ modulo \ 256$ 

### Adressing (only for RS232/RS485)



< DC2 > = 18(dec.) = \$12 3 = 3(dez.) = \$03 A = 65(dez.) = \$41

select or deselect: S' = \$53 or D' = \$44

adr = 0..255

 $bcc = 1 \ byte = sum \ of \ all \ bytes \ incl. < DC2> \ and \ adr, \ modulo \ 256$ 

 $\langle ACK \rangle = 6(dec.) = \$06$ 

If the most recently requested package contains an incorrect checksum, the entire package can be requested again. The reply can then be the contents of the send buffer (<DC1>) or the buffer/protocol information (<DC2>).

This command can be used to select or deselect the eDIP with the address adr.



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### **TERMINAL MODE**

When you switch the unit on, the cursor flashes in the first line, indicating that the display is ready for operation. All the incoming characters are displayed in ASCII format on the terminal (exception: CR,LF,FF,ESC,'#'). The prerequisite for this is a working protocol frame or a deactivated protocol (see pages 10 and 11).

Line breaks are automatic or can be executed by means of the 'LF' character. If the last line is full, the contents of the terminal scroll upward. The 'FF' character (page feed) deletes the terminal.

The character '#' is used as an escape character and thus cannot be displayed directly on the terminal. If the character '#' is to be output on the terminal, it must be transmitted twice: '##'.

The size of the terminal-window can be set by command 'ESC TW'.

**Attention:** Graphic commands are able to draw inside terminal window. For example 'ESC DL' will delete terminal window, too.

+ Lower Upper	\$0 (0)	\$1 (1)	\$2 (2)	\$3 (3)	\$4 (4)	\$5 (5)	\$6 (6)	\$7 (7)	\$8 (8)	\$9 (9)	\$A (10)	\$B (11)	\$C (12)	\$D (13)	\$E (14)	\$F (15)
\$00 (dez: 0)	NOL	ᡠ	Ω	♦	¢	<b>V</b>	1		+	н	L <sub>F</sub>	Ţ	F	C R	S O	S
\$10 (dez: 16)	0	1	2	3	Ч	5	8	ŋ	8	9	0	E <sub>S</sub>	1	Į.	÷	+
\$20 (dez: 32)		!	ш	#	\$	γ.	&	ı	(	)	¥	+	,	-		7
\$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	1	;	<	=	>	?
\$40 (dez: 64)	0	A	В	C	D	Ε	F	G	Н	Ι	J	K	L	M	N	0
\$50 (dez: 80)	P	Q	R	S	T	U	V	М	X	Y	Z	[	٨	1	٨	_
\$60 (dez: 96)	`	a	b	С	d	е	f	g	h	i	j	k	1	m	n	0
\$70 (dez: 112)	р	q	Γ	s	t	u	٧	М	X	y	z	{	I	}	~	Δ
\$80 (dez: 128)	Ç	ü	é	â	ä	à	å	Ç	ê	ë	è	ï	î	ì	Ä	Å
\$90 (dez: 144)	É	æ	Æ	ô	ö	ò	û	ù	ÿ	ö	Ü	¢	£	¥	β	f
\$A0 (dez: 160)	á	í	ó	ú	ñ	Ñ	<u>a</u>	Ō	ż	-	7	ķ	~	i	«	>>
\$B0 (dez: 176)	::			I	+	1	1	П	7	1		11	ī	П	4	٦
\$C0 (dez: 192)	L	Т	т	ŀ	-	+	F	ŀ	F	lī	ΤĪ	īī	ŀ	=	#	±
\$D0 (dez: 208)	Ш	₹	π	Ш	F	F	п	#	ŧ	1	г					
\$E0 (dez: 224)	α	β	Γ	π	Σ	σ	Д	τ	Φ	Θ	Ω	δ	Ф	ф	Ε	Π
\$F0 (dez: 240)	=	±	<u>&gt;</u>	<	ſ	J	÷	z	٥	•		٠.	n	2	3	-

Terminal-Font 2: 8x16

### **USING THE SERIAL INTERFACE**

The operating unit can be programmed by means of various integrated commands. Each command begins with ESCAPE followed by one or two command letters and then parameters.

There are two ways to transmit commands:

### 1. ASCII mode

- The ESC character corresponds to the character '#' (hex: \$23, dec: 35).
- The command letters come directly after the '#' character.
- The parameters are transmitted as plain text (several ASCII characters) followed by a separating character (such as a comma ',') also after the last parameter e.g.: **#GD0,0,479,271**,
- Strings (text) are written directly without quotation marks and concluded with CR (hex: \$0D) or LF (hex: \$0A).

### 2. Binary mode

- The escape character corresponds to the character ESC (hex: \$1B, dec: 27).
- The command letters are transmitted directly.
- The coordinates xx and yy are transmitted as 16-bit binary values (first the LOW byte and then the HIGH byte).
- All the other parameters are transmitted as 8-bit binary values (1 byte).
- Strings (text) are concluded with CR (hex: \$0D) or LF (hex: \$0A) or NUL (hex: \$00).

No separating characters, such as spaces or commas, may be used in binary mode.

The commands require **no final byte**, such as a carriage return (apart from the string \$00).



### **ALL COMMANDS AT A GLANCE**

The built-in intelligence allows an easy creation of your individual screen content. Below mentioned commands can be used either directly via the serial interface (see page 12) or together with the self-definable macro (see pages 26/28).

					EΑ	eDl	PTF	-T4:	3-A: Terminal commands	after
Command	Cod	es							Remarks	reset
Set terminal color	ESC	F	Т	fg	bg				Preset color for terminal mode: fg= foreground color; bg= background color	8,1
Define window	ESC	т	w	n1	С	L	W	Н	The terminal output is executed with font n1: 1=8x8; 2=8x16 only within the window from column and line L (=upper-left corner) with a width of W and a height of H (specifications in characters). Display organisation 480x272: C=160; L=134/17; 272x480: C=134; L=160/30	08x16 1,1 60,17
Form feed FF (dec:12)	^L				•				The contents of the screen are deleted and the cursor is placed at pos. (1,1)	
Carriage return CR (13)	^M								Cursor to the beginning of the line on the extreme left	
Line feed LF (dec:10)	^J								Cursor 1 line lower, if cursor in last line then scroll	
Position cursor			Р	С	L				C=column; L=line; origin upper-left corner (1,1)	1,1
Cursor on/off			С	n1					n1=0: Cursor is invisible; n1=1: Cursor flashes;	1
Save cursor position	ESC	-	s						The current cursor position is saved	
Restore cursor position		•	R						The last saved cursor position is restored	
Terminal off			Α						Terminal display is switched off; outputs are rejected	
Terminal on			Е						Terminal display is switched on;	on
Output version			٧						The version no. is output in the terminal e.g. "EA eDIPTFT43-A V1.0 Rev.A"	
Output projectname	ESC	Т	J						The macrofile-projectname is output in the terminal e.g. "init / delivery state"	
Output interface			Q						The used interface is output in the terminal e.g "RS232,115200 baud,ADR: \$07"	
Output informationen	ESC	Т	ı						The terminal is initialisized and cleared; the software version, hardware revision, macrofile-projectname and CRC-checksum are output in the terminal	

					ΕA	еD	IPT	FT4	3-A: G	aph	ic commands	after
Command	Cod	les							Remark			reset
	<u> </u>				Di	splay	con	nmar	nds (effec	t on t	ne entire display)	
Set display color	ESC	F	D	fg	bg				Defines co	lor 1:	32 for display and areas: fg=foreground color; bg=background color	8,1
Set display orientation			0	n1					n1=0: 0°;	1=1: 9	90°; n1=2: 180°; n1=3: 270° (0°+180°=480x272; 90°+270°=272x480)	0°
Delete display			L						Delete dis	olay co	ontents (all pixels to background color)	
Fill display	ESC	D	S						Fill display	conte	nts (all pixels to foreground color)	
Fill display with color			F	n1					Fill comple	te disp	play content with color n1=132	
Invert display			1						Invert disp	lay coi	ntent	
·	•						(	Comi	mands fo	outp	utting strings	- U
Set text color	ESC	F	Z	fg	bg				Color 13	2 (0=tra	ansparent) for string and character: fg=text color; bg=background color	8,0
Set font			F	n1					Set font w	th the	number n1	3
Font zoom factor			Z	n1	n2				n1 = X-zo	m fac	tor (1x to 8x); n2 = Y-zoom factor (1x to 8x)	1,1
Additional width/height	ESC	z	Υ	n1	n2						nal width left/right; n2=015: additional height top/bottom	0, 0
Spacewidth			J	n1					n1=0: use	space	width from font; n1=1: same witdh as a number; n1>=2 width in dot	0
Text angle	_		w	n1						_	e: n1=0: 0°; n1=1: 90°; n1=2: 180°; n1=3: 270°	0
Output string			L	T	İ						tput to xx1,yy1	
L: left justified	F00	_		١		te	xt				JL' (\$00), 'LF' (\$0A) or 'CR' (\$0D)	
C: centered	ESC	Z	С	xx1	yy1			NUL			separated by the character ' ' (\$7C, pipe)	
R: right justified			R						the charac	ter '\' (	\$5C, backslash) cancles the special function of ' ' and '\'	
Output string											Output a string () inside area from xx1,yy1 to xx2,yy2 at position n1=19; the will be filled with background color;	area
in an area	ESC	z	В	xx1	yy1	xx2	1/1/2	n1	text		n1=1: Top Left; n1=2: Top Center; n1=3: Top Right	
(since V1.2)		_	"	^^1	уу	^^2	y y Z				n1=1: 16p Lett, 111=2: 16p Genter, 111=3: 16p Hight	
(31100 ¥ 1.2)											n1=7: Bottom Left; n1=8: Bottom Center; n1=9: Bottom Right	
String for terminal	ESC	Z	Т			text			Command	for ou	tputting a string from a macro to the terminal	
								Dra	w straigh	t line:	s and points	
Set color for lines	ESC	F	G	fg	bg				Colors 1	32 (0=t	ransparent): fg = color for line; bg = pattern background	8,1
Draw rectangle			R	xx1	yy1	xx2	yy2		Draw four	straigh	It lines as a rectangle from xx1,yy1 to xx2,yy2	
Draw straight line			D	xx1	yy1	xx2	yy2		Draw strai	ght line	e from xx1,yy1 to xx2,yy2	
Continue straight line	ESC	G	W	xx1	yy1				Draw a str	aight li	ne from last end point to xx1, yy1	
Draw point		G	Р	xx1	yy1				Set a poin	at co	ordinates xx1, yy1	
Point size/line thickness			Z	n1	n2				n1 = X-po	nt size	(1 to 15); n2 = Y-point size (1 to 15);	1,1
Pattern			M	n1					Set straigl	t line/p	point pattern no. n1=1255; 0=do not use pattern	0
Set start point			S	xx1	yy1				Set the las	t end	point at coordinates xx1, yy1 for commands 'GW', 'GX' and 'GY' (since V1.5)	
Draw X-Graph			х	xs	ya	yy1			Draw grap	h with	fix x-steps (xs=1127 or 129255 for neg. steps) and variable amount (ya=12	255)
Diaw X Graph	ESC	G		۸۵	yα	уу			of y-value			
Draw Y-Graph			Υ	ys	ха	xx1			Draw grap of x-value		fix y-steps (ys=1127 or 129255 for neg. steps) and variable amount (xa=12 e V1.5)	255)
				-				Cha		_	ngular areas	
Delete area			L	xx1	yy1	xx2	yy2				om xx1,yy1 to xx2,yy2 (fill with background color)	
Fill area			s	xx1	yy1	xx2	yy2				xx1,yy1 to xx2,yy2 (fill with foreground color)	
Fill area with color	ESC	R	F	xx1	yy1	xx2	yy2	n1			xx1,yy1 to xx2,yy2 with color n1=132	
Invert area	_		ı	xx1	yy1	xx2	yy2				om xx1,yy1 to xx2,yy2	
Copy area	_		c	xx1	yy1	xx2	yy2	ххЗ			ea from xx1,yy1 to xx2,yy2 to new position xx3,yy3	1
Patterncolor		F	М	fq	bq		,,,	Ĺ			ansp.) for monochrome pattern: fg=foreground; bg=background color	8.1
Area with fill pattern	ESC		М	xx1	vy1	xx2	vv2	n1		_	m xx1,yy1 to xx2,yy2 with pattern n1	-,.
Draw box		R	0	xx1	yy1	xx2	yy2				xx1,yy1 to xx2,yy2 and fill with pattern n1	1
Set color for border		F	R	c1	c2	c3	,,_				der segments: c1=frame outside; c2=frame inside; c3=filling	8.1.1
Set border type	ESC		E	n1	n2						, , ,	1, 0
		R									n1=1255; border angle: n2=0: 0°; n1=1: 90°; n1=2: 180°; n1=3: 270°	



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			Е	Ае	DIP	TFT	<sup>-</sup> 43-	A: E	Bitmap / Animation commands	after			
Command	Coc	les							Remarks	reset			
								Е	Bitmap image commands	L			
Set bitmap colors	ESC	F	U	fg	bg				painting color for monchrome bitmaps fg=foreground color; bg=background color	1,8			
Image zoom factor			Z	n1	n2				n1 = X-zoom factor (1x to 8x); n2 = Y-zoom factor (1x to 8x)	1,1			
Image angle			w	n1					output angle of the image: n1=0: 0°; n1=1: 90°; n1=2: 180°; n1=3: 270°	0			
Mirror Image		١	х	n1					n1=0: normal display; n1=1: the image is mirrored horizontally	0			
Transparency for color bitmaps	ESC	U	т	n1					n1=0: no transparency; show picture with all colors rectangular n1=1: color of the first dot at top left side will be defined as transparent (like a mask) n1=2: if defined - use transparent color from bitmap-file (.GIF .TGA .G16) n1=3: replace transparent color from bitmap-file with actually background color	2			
Load internal image	ESC	U	_	xx1	yy1	nr			Load internal image with the no (0 to 255) from the data flash memory to xx1,yy1				
Load image	ESC	١٠	L	xx1	yy1	G1	6 data	a	Load an image to xx1,yy1; see image structure (G16 format) for image data				
RLE compression	ESC	U	R						the next hardcopy ('ESC U H xx1,yy1,xx2,yy2) is send with RLE compression (since V1.5)				
Send hardcopy	ESC	U	Н	xx1	yy1	xx2	yy2		After this command, the image extract is sent (to sendbuffer) in G16 format				
								An	imation image commands				
Set animation colors	ESC	F	W	fg	bg				color for monchrome animation images fg=foreground color; bg=background color	1,8			
Animation zoom factor			Z	n1	n2				n1 = X-zoom factor (1x to 8x); n2 = Y-zoom factor (1x to 8x)	1,1			
Animation angle			W	n1					output angle of the animation image n1=0: 0°; n1=1: 90°; n1=2: 180°; n1=3: 270°	0			
Mirror animation	ESC	l	Х	n1					n1=0: normal display; n1=1: the animation image is mirrored horizontally	0			
Transparency for color animation	ESC	w	т	n1			ā		n1=0: no transparency; show animation with all colors rectangular n1=1: color of the first dot at top left side will be defined as transparent (like a mask) n1=2: if defined - use transparent color from animation-file (.GIF .G16) n1=3: replace transparent color from animation-file with actually background color				
Load single image	ESC	W	ı	xx1	yy1	n1	n2		Load from animation n1=0255 the single image n2 to xx1,yy1				
Define animationprocess	ESC	w	D	no	xx1	yy1	n2	type	Define an animationprocess no=14 at position xx1,yy1 (=left top edge) with animation in n2=0255.  time type: 1=run once; 2=cyclically; 3=pingpong; 4=once backwards; 5=cyclic backwards 6=pingpong backwards; 7=manually (use command ESC W NIPIFIM) time: 0=stop; 1254=time in in 1/10 sec; 255=use time from animation-file	nage			
Change animation type			Υ	no	type				Assign a new type=17 to animationprocess no=14				
Change animation time			С	no	time				Assign a new time=0255 to animationprocess no=14				
Next animation image			N	no					Show the next image from animationprocess no=14				
Previous animation image	ESC	w	Р	no					Show the previous image from animationprocess no=14				
Show animation image			F	no	n2				Show image n2 from animationprocess no=14				
Run to animation image			М	no	n2				Run animationprocess no=14 from actually image to image n2				
Stop animationprocess	L no					Stop animationprocess no=14 and clear last image with actually background color							



					EΑ	eDI	PTF	T43	3-A:	Ba	rgra	aph commands	after				
Command	Cod	es							Ren				reset				
	<u>-</u>								Bar	gra	oh co	mmands					
Set color for bargraph	ESC	F	В	fg	bg	fc			Colo	rs: fg	= fore	ground; bg = background; fc = color for frame	8,1,8				
Bargraph pattern			M	n1					Patte	ern fo	r barg	raph n1=1255; n1=0 no pattern/solid (valid for type=03)	0				
Bargraph border	ESC	В	Е	n1					Bord	er fo	r bargı	raph n1=1255 (valid for type=47)	1				
Bargraph linewidth			В	n1					Linev	width	for ba	rgraph n1=1255; n1=0 automatic (valid for type=2,3,6,7)	0				
Define bargraph	ESC	В	R L O U	no	xx1	уу1	xx2	уу2	sv	lype: 2=pattern line; 3=pattern line in rectangle; type: 4=border bar; 5=border bar in rectangle; type: 6=border line; 7=border line in rectangle; Set and draw the bargraph with the number no=120 to the new value val							
Update bargraph			Α	no	val				Set a	and d	raw th	7 9					
Draw bargraph			N	no					Entire	ely re	edraw	the bargraph with the number no=120					
Send bargraph value	ESC	В	S	no					Send	the	currer	it value of bargraph number no=120 to sendbuffer					
Delete bargraph			D	no	n2				If the	Send the current value or bargraph number no=120 to sendouner  The definition of the bar graph with the number no=120 becomes invalid.  If the bar graph was defined as input with touch, this touch field will also be deleted.  n2=0: Bar graph remains visible; n2=1: Bar graph is deleted							
	<u>-</u>						Use	r val				ext output					
User value color	ESC	F	Х	fg	bg				Set o	olor	for ba	rgraph user value; fg=foreground, bg=background color	8,1				
User value font			F	n1					Set for	ont n	1 for b	pargraph user value	5				
User value zoom			Z	n1	n2				Set z	coom	factor	for bargraph user value; n1=X-Zoom 1x8x; n2=Y-Zoom 1x8x	1,1				
User value additional width/height	ESC	В	Y	n1	n2						onal width left/right; onal height top/bottom for bargraph user value;	0, 0					
User value angle			W	n1					Set v	vritin	g angl	e for bargraph user value; n1=0: 0°; n1=1: 90°; n1=2: 180°; n1=3: 270°;	0°				
User values / scaling	ESC	В	х	no	xx1	уу1	For mat Str ing	NUL	Define user value for bargraph no=120. Output is always right justified to xx1,yy1; Format String: "bv1=uservalue1;bv2=uservalue2". 'NUL' (\$00) = termination; Assign two bar values (bv1,bv2 =0254) to user defined values max. range: 4 1/2 digits 19999 + decimal point ('.' oder ',') + sign e.g. display "-123.4" for bar value bv1=0 and "567.8" for bar value bv2=100 Format String: "0=-123.4;100=567.8"								

			EΑ	eDI	PTF	T43	3-A:	Ins	trui	men	t commands (since V1.4)	after					
Command	Cod								_	nark		reset					
									Defin	e, us	se instruments						
Definine instrument	ESC	ı	Р	n1	xx1	yy1	yy1 n2 n3			ew	Define instrument n1=14 an xx1,yy1 (=left top edge); Use intrument image n2=0255 Output angle n3=0: 0°; n3=1: 90°; n3=2: 180°; n3=3: 270°; aw, ew (0254) are start and endvalue (0% and 100%).	nothing definied					
Update instrument			Α	n1	val		•		Upda	ate ins	strument with new value and redraw						
Redraw instrument			N	n1					Redr	aw er	ntirely instument n1=14						
Send instrument value	ESC	1	S	n1					Send	d actu	al instrument value n1=14 to send buffer						
Delete instrument			D	n1	n2			The definition of the instrumets gets invalid. If the instrument was adjustable by touch, the touch area will be deleted, too.  n2=0: Instrument stays visible; n2=1: Instrument is deleted completely									
						U	ser v	alue	s - fo	rmat	ted string output						
User value color	ESC	F	ı	vf	hf				Set o	color 1	32 for instrument user value fg=foreground; bg=background color	8,1					
User value font			F	n1					Set f	ont nr	for instrument user value	5					
User value zoom			Z	n1	n2				Set z	zoom 1	factor for instrument user value: n1=X-Zoom 1x8x; n2=Y-Zoom 1x8x	1,1					
User value additional hight/width	ESC	ı	Υ	n1	n2						additional width left/right; additional height top/bottom for instrument user value;	0, 0					
User value angle			W	n1					Set v	vriting	angle for instrument user value: n1=0: 0°; n1=1: 90°; n1=2: 180°; n1=3: 270°	0°					
User values / scaling	ESC	ı	x	n1	xx1	yy1	For mat Str ing	NUL	Define user value for instrument no=14. Output is right justified to x1,y1 Format String: "iv1=uservalue1;iv2=uservalue2" Assign two instrument values (iv1,iv2 =0254) to user defined values max. range: 4 1/2 digits 1\$ + decimal point ('.' or ',') + sign e.g. display "-123.4" for iv1=0 and "567.8" for iv2=100 Format String: "0=-123.4;100=567.8"								



		E	A el	DIP.	TFT	43-	A: A	\nal	ogue input AIN1, AIN2 commands	after
Command	Cod								Remarks	reset
								Con	nmands for analogue inputs	
Calibration	ESC	٧	@	ch	xx1				Calibration procedure is as follows:  1.) Apply defined voltage (35V) to AIN1 (channel1) or AIN2 (channel2)  2.) Run this command with channel information ch=12 and xx1=voltage value [mV] (16-Bit) e.g. 4.0V on AIN1; Command: "#V@1,4000;"	not calib rated
Enable/disable AIN scan			Α	n1					n1=0 disables input scan for AIN1 and AIN2; n1=1 enable input scan	0
Send analog value			D	ch					Voltage in [mV] will be sent (to sendbuffer) for channel ch=12	
Limit for analog macro	ESC	V	к	ch	n1	n2	n3		Sets two limits for channel ch=12. n1=lower limit [mV/20]; n2=upper limit [mV/20]; n3=hysteresis [mV] Related to this limits serveral analogmacros can be started automatically.	0
Redefine analoguemacro (since V1.1)	ESC	٧	М	n1	n2				Assign analoguemacrofunction n1=019 with analoguemacro number n2=0255.	
Bargraph for AIN1/AIN2			В	ch	no	(it i De			Assigns bargraph no=120 to analogue input ch=12 (it is possible to assign more than one bargraph to an anlogue input). Define start- endvalues (sv, ev) for bargraph in [mV/20] (see comand 'ESC B RLOU')	
Instrument for AIN1/AIN2 (since V1.4)	ESC	V	+	ch	no	A D			Assigns instrument no=14 to analogue input ch=12 Define start- endvalues (sv, ev) for instrument in [mV/20]	
Redraw bargraph			R	ch					Redraw all bar graphs defined for channel ch=12	
								User	values - Format text output	
User value color		F	٧	ch	fg	bg			Set color for string output of channel ch=12; fg= foreground, bg= background color	8,1
User value Font			F	ch	n1				Set font n1 for channel ch=12	5
User value zoom	ESC		Z	ch	n1	n2			Set zoom factor for channel ch=12; n1=X-Zoom 1x8x; n2=Y-Zoom 1x8x	1,1
User value additional width/height		٧	Y	ch	n1	n2			n1=015: additional width left/right; n2=015: additional height top/bottom for channel ch=12;	0, 0
User value angle			w	ch	n1				Set writing angle for channel ch=12; n1=0: 0°; n1=1: 90°; n1=2: 180°; n1=3: 270°;	0
User values / scaling	ESC	v	E	ch	forr	mat string A		NUL	Set user value for channel ch=12. Format String: "mV1=uservalue1;mV2=uservalue2". 'NUL' (\$00) = termination Assign two voltages (0.5000mV) to user defined values max. range: 4 1/2 digits 19999 + decimal point ('.' oder ',') + sign e.g. display for 2000 mV input should be "-123.45" and "0.00" for 1000mV Format String: "2000=-123.45;1000=0"	0 =0.00 5000 =5.00
Send user value			S	ch				-	This will send current voltage as formated string for channel ch=12 to sendbuffer	
Display on terminal	ESC	V	T	ch					Show formated string of channel ch=12 on termial window	
Display user value			G	ch	xx1	yy1			Show formated string of channel ch=12 at coordinate xx1,yy1	

EA eDIPTF								ΓFΤ	43-A: Macro commands	after					
Command	Cod	des							Remarks	reset					
									Macro commands						
Run macro			N	no					Call the (normal) macro with the number no (max. 7 levels)						
Run touch macros			Т	no					Call the touch macro with the number no (max. 7 levels)						
Run port macro			Р	no					Call the port macro with the number no (max. 7 levels)						
Run bit macro	ESC	М	В	no					Call the bit macro with the number no (max. 7 levels)						
Run matrix macro			X	no					Call the matrix macro with the number (max. 7 levels)						
Run process macro			С	no					Call the process macro with the number (max. 7 levels)						
Run analogue macro			٧	no					Call the analogue macro with the number no (max. 7 levels)						
Disable macros	ESC	м	L	type	n1	n2			Macros of the type'N','T','P','B','X','C' or 'V' (type 'A' = all macro types) are disabled from the number n1 to n2; i.e. no longer run when called.						
Enable macros	ESC	IVI	U	type	n1   n2   n1			Macros of the type 'N', T', 'P', 'B', 'X', 'C' or 'V' (type 'A' = all macro types) are enabled from numbe n1 to n2; i.e. run again when called.	r						
Select macro/image page	ESC	м	к	n1	A p h				A page is selected for macros and images n1=0 to 15. if a macro/image is not defined in the cur page 1 to 15, this macro/image is taken from page 0 (e.g. to switch languages or for horizontal/vertical installation).	rent					
Save macro/image page			W						the current macro/image page is saved (when used in process macros)						
Restore macro/imagepage			R						the last saved macro/image page is restored						
	-							Α	utomatic (normal-) macro	•					
Macro with delay			G	n1	n2				Call the (normal) macro with the number n1 in n2/10s. Execution is stopped by commands (e.g. receipt or touch macros).						
Autom. macros once only	ESC	м	Е	n1	n2	n3			Automatically run macros n1 to n2 once only; n3=pause in 1/10s. Execution is stopped by comm (e.g. receipt or touch macros).	ands					
Autom. macros cyclical	ESC	IVI	Α	n1	n2	n3			Automatically run macros n1 to n2 cyclically; n3=pause in 1/10s. Execution is stopped by comm (e.g. receipt or touch macros).	ands					
Autom. macros ping pong			J	n1	n2	n3			Automatically run macros n1 to n2 to n1 (ping pong); n3=pause in 1/10s. Execution is stopped, texample, by receipt or touch macros.	for					
									Macro processes						
Define macro process			D	no	type	n3	n4	zs	A macro process with the number no (1 to 4) is defined (1=highest priority).  The process macros n3 to n4 are run successively every zs/10s.  type: 1=once only: 2=cyclical: 3=ping pong n3 to n4 to n3						
Macro process interval	ESC	М	z	no	zs	<sub>7S</sub> a		a new time zs in 1/10s is assigned to the macro process with the number no (1 to 4). if the time zs=0, execution is stopped.							
Stop macro processes			s	n1		All			All macro processes and animations are stopped with n1=0 and restarted with n1=1 in order, example, to execute settings and outputs via the interface undisturbed						



sc	Y	H N P Z L B	n1 n1 n1 n0				Remarks  Backlight commands  Set brightness of the LED illumination n1=0 to 100%. Increase brightness of the LED illumination (one step=1%)  Decrease brightness of the LED illumination (one step=1%)  Time n1=031 in 1/10sec for changing brightness from 0 to 100%  LED n1=0: OFF; n1=1: ON; n1=2 to 255: LED switched ON for n1/10sec  Assign bar no=1, 20 for changing brightness of the backlight	100 5 1					
sc	Υ	N P Z L B	n1 n1 no				Set brightness of the LED illumination n1=0 to 100%. Increase brightness of the LED illumination (one step=1%) Decrease brightness of the LED illumination (one step=1%) Time n1=031 in 1/10sec for changing brightness from 0 to 100% LED n1=0: OFF; n1=1: ON; n1=2 to 255: LED switched ON for n1/10sec	5					
sc	Y	N P Z L B	n1 n1 no				Increase brightness of the LED illumination (one step=1%)  Decrease brightness of the LED illumination (one step=1%)  Time n1=031 in 1/10sec for changing brightness from 0 to 100%  LED n1=0: OFF; n1=1: ON; n1=2 to 255: LED switched ON for n1/10sec	5					
sc	Y	P Z L B	n1 no				Decrease brightness of the LED illumination (one step=1%) Time n1=031 in 1/10sec for changing brightness from 0 to 100% LED n1=0: OFF; n1=1: ON; n1=2 to 255: LED switched ON for n1/10sec						
sc	Y	Z L B	n1 no				Time n1=031 in 1/10sec for changing brightness from 0 to 100%  LED n1=0: OFF; n1=1: ON; n1=2 to 255: LED switched ON for n1/10sec						
sc	Y	L B	n1 no				LED n1=0: OFF; n1=1: ON; n1=2 to 255: LED switched ON for n1/10sec						
SC	Υ	B +	no					1					
		+					Assign har no-1 20 for changing brightness of the hacklight						
			n1				Assign bar no=120 for changing brightness of the backlight						
 		@					Brightness is connected to instrument 14.	1					
			1	•			Save the actual brightness and changetime for poweron to EEPROM						
							Port commands						
		w	n1	n2			n1=0: Set all 8 output ports in accordance with n2 (=8-bit binary value) n1=18: Reset output port n1 (n2=0); set (n2=1); invert (n2=2)	Ports 1-8=0					
_		R	n1		n1		n1=0: Read all 8 input ports as 8-bit binary value (to sendbuffer) n1=18: Read input port <n1> (1=H-level=5V, 0=L-level=0V)</n1>						
c	Υ	Α	n1				The automatic scan of the input port is n1=0: deactivated; n1=1: activated	1					
		ı	n1				The input port is n1=0: normal; n1=1: evaluated inverted	0					
		М	n1	n2	n2 n2		Specifies an external matrix keyboard at the inputs and outputs. n1=number of inputs (18); n2=number of outputs (08); n3=debouncing (07)	0					
	,,	D	n1	n2	n3		input port n1=18 is assigned by falling edge n2=0 to new BitMacro number n3=0255 input port n1=18 is assigned by rising edge n2=1 to new BitMacro number n3=0255						
SC	Y	х	n1	n2			Assign keynumber n1=165 with matrixmacro number n2=0255 After release the key n1=0 run matrixmacro number n2=0255						
с	Υ	Е	n1	n2	n3		Set the outputs of the external 74HC4094 (refer to page 8) from port n1=0255 to port n2=025 n3=0: low; n3=1: high; n3=2: invert;	5;					
		•				•	Other commands						
С	F	Р	no	R5	G6	B5	Set a new RGB value for color no. n1=132 (R5:Bit73; G6:Bit72; B5:Bit73)						
С	Х	n1					Wait n1 tenths of a second before the next command is executed.						
С	κ	Α	adr				For RS232/RS485 operation only and only possible when Hardware address is 0. The eDIP is assigned a new address adr (in the Power-On macro).						
С	s	Т	n1				n1=0: no use of internal strings n1>0: after code n1 appears following codes are internal string numbers (since V1.5)						
C	Υ	S	n1				The tone output (pin 16) becomes n1=0:OFF; n1=1:ON; n1=2 to 255:ON for n1/10s	OFF					
		В	num		data I		num (=1 to 255) bytes are sent to the sendbuffer data = num Bytes.						
c	S	٧					The version is sent as a string to sendbuffer e.g. "EA eDIPTFT43-A V1.0 Rev.A TP+"						
		J					The macro-projectname is sent as a string to the sendbuffer e.g. "init / delivery state"						
	SC SC SC SC SC SC SC SC	GC Y  GC Y  GC F  GC X  GC K  GC S  GC Y	GC Y E  GC Y E  GC X n1  GC X n2  GC X n2  GC X n3  GC X n4  GC X n5  GC X	C Y E n1  C Y E n1  C Y E n1  C Y S n1  C S T n1	R	R n1  A n1  I n1  M n1 n2 n3  C Y D n1 n2 n3  C Y E n1 n2 n3  C Y E n1 n2 n3  C X n1   R n1 A n1 I n1 M n1 n2 n3 C Y D n1 n2 n3 X n1 n2 C Y E n1 n2 n3 C X n1 C	N=18: Heset output port n1 (n2=0); set (n2=1); invert (n2=2)						



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### **TOUCH PANEL**

The Version EA eDIPTFT43-ATP is shipped with an analog, resistive touch panel. Up to 60 touch areas (keys, switches, menus, bar graph inputs) can be defined simultaneously. The fields can be defined with pixel accuracy. The display supports user-friendly commands. When the touch "keys" are touched, they can be automatically inverted and an external tone can sound (pin 16), indicating they have been touched. The predefined return code of the "key" is transmitted via the interface, or an internal touch macro with the number of the return code is started instead.

			E	<u>A</u> e	DIP	<u>ΓFΤ</u>	<u>43-</u> /	<u> 4: C</u>	<u>om</u> n	<u>nan</u>	<u>ds</u>	for the touch panel	after			
Command	Cod	les							Rem			<u>.</u>	reset			
									Т	ouc	h pre	esets				
Touch bordercolors	ESC	F	Е	n1	n2	n3	s1	s2				ors (032) for touch borders (ESC AT AK). s=selected; 1=frame outside; 2=frame inside; 3=filling	8,1,2 8,1,7			
Touch borderform		Α	Е	n1	n2				n1=1	255	oorde	r number; n1=0 no border; n2=angle 0=0°; 1=90°; 2=180°; 3=270°	1,0			
Touch button colors	ESC	F	С	nf	nb	sf	sb					32) for monochrome touch buttons (ESC AU AJ). ected; f=foreground; b=background	8,1 8,1			
Touch button number	7	Α	С	n1	n2	n3	n4		n1=0	255	outtor	n number; n2=button angle; n3=X-Zoom 18; n4=Y-Zoom 18	1,0,1,1			
Radio group for switches	ESC	Α	R	n1					n1=1 t Only 1 of a sv	to 25 swit witch	5: nev ch in in a g	ned switches do not belong to a group.  why defined switches belong to the group with the number n1.  a group is active at any one time; all the others are deactivated. In the case group, only the down code is applicable. the up code is ignored.	0			
Fant color	F00	-		n.f	of						_	resets	0.1			
Font color	ESC	F	A F	nf n1	sf							abeling. nf=normal fontcolor; sf= fontcolor for selection	8,1			
Label font Label zoom factor			Z		-0							number n1 for touch key label	5			
	ESC	Α	Y	n1	n2 n2							tor (1x to 8x); n2 = Y-zoom factor (1x to 8x)	1,1			
Additional width/height	ESC	A		n1	112	l						onal width left/right; n2=015: additional height top/bottom	0,0			
Label angle			W	n1		ı						yle: n1=0: 0°; n1=1: 90°; n1=2: 180°; n1=3: 270°	0			
Offset for selected label			0	n1	n2				1			-Y-offset; n1,n2=07 (add +8 for negative direction)	0, 0			
	1	1	1	1	1	1	1	1	Det	ine t	ouci	n areas T: The area from xx1,yy1 to xx2,yy2 is defined as a key				
Define touch key	ESC	А	т	xx1	yy1	xx2	уу2	dow Cod	up Cod	text 	NUL	K': The area from xx1,yy1 to xx2,yy2 is defined as a switch U: The actual button is loaded to xx1,yy2 and defined as a key U: The actual button is loaded to xx1,yy2 and defined as a switch 'down code':(1-255) return/touchmacro when key pressed. 'up code': (1-255) return/touchmacro when key released. (down/up code = 0 press/release not reported).  **text': this is a string that is placed in the key with the current touch font.				
			U	xx1	yy1	dow Cod	up Cod	text	NUL			The first character determines the alignment of the text (C=centered, L=left				
Define touch switch (status of the switch	ESC	А	к	xx1	уу1	xx2	уу2	dow Cod	up Cod	text 	NUL	justified, R=right justified). Multiline texts are separated with the character ' ' (\$7C, dec: 124); optional: after the character '~' (\$7E, dec: 126) you can write a 2nd text for a				
toggles after each contact)			J	xx1	yy1	dow Cod	up Cod	text	NUL			selected touch key/switch e.g. "LED on~LED off"  nul': (\$00) = end of string				
Define drawing area	ESC	А	D	xx1	yy1	xx2	yy2	n1				area is defined. You can then draw with a line width of n1 and color fg within coordinates xx1,yy1 and xx2,yy2.				
Define free touch area	ESC	A	н	xx1	yy1	xx2	уу2					able touch area is defined. Touch actions (down, up and drag) within the rdinates xx1,yy1 and xx2,yy2 are sent.				
Set bar by touch	ESC	Α	В	n1						The b	argra	uph with number n1 is defined for input by touch panel.				
Set instrument by touch (since V1.4)	ESC	A	+	n1						The i	nstrur	ment with number n1 is defined for input by touch panel.				
									G	loba	l set	tings				
Touch query on/off	ESC	Α	Α	n1					Touch	que	y is d	leactivated (n1=0) or activated (n1=1)	1			
Touch key response	ESC	А	ı	n1					Autom	atic i	nvers	ion when touch key touched: n1=0=OFF; n1=1=ON;	1			
Touch key response		^	S	n1					Tone:	soun	ds bri	efly when a touch key is touched: n1=0=OFF; n1=1=ON	1			
Send bar value on/off	ESC	A	Q	n1					Automatic transmission of a new bar graph / instrument value by touch input is n1=0: deactivated; n1=1: is placed in the sendbuffer once at the end of input n1=2: changes are placed continious in the sendbuffer during input				1			
				-					0	ther	func	tions				
Invert touch key			N	code					The to	uch l	key w	ith the assigned return code is inverted manually				
Set touch switch			Р	code	n1				The st	atus	of the	switch is changed by means of a command (n1=0=off; n1=1=on)				
Query touch switch	ESC	Α	Х	code					The st	atus	of the	switch with the return code (off=0; on=1) is placed in the sendbuffer				
Query radio group	1		G	n1					down	code	of the	e activated switch from the radio group n1 is placed in the sendbuffer				
	ESC	А	L	code	n1				The touch area with the return code (code=0: all touch areas) is removed from the touch query. n1=0 the area remains visible on the display; n1=1, the area is deleted.							
Delete touch area	ESC	^	v	xx1	yy1	n1						ch area that includes the coordinates xx1,yy1 from the touch query.				
L		<u> </u>		1	1	<u> </u>	1		n1=0: area remains visible; n1=1: Delete area							



### TOUICH ADJUSTMENT

The touch panel is perfectly adjusted and immediately ready for operation on delivery. As a result of aging and wear, it may become necessary to readjust the touch panel:

- 1a. Send Command 'ESC A@' or
- 1b. Touch the touch panel at power-on and keep it depressed. After the message "touch adjustment ?" appears, release the touch panel. Touch the touch panel again within a second for at least a second.
- 2. Follow the instructions for adjustment (press the 2 points upper left and lower right).

### RESPONSE OF THE EA eDIPTFT43-A VIA SERIAL INTERFACE

The table below contains all response codes. Some response data will come automatically some others on request. In addition to that with command 'ESC SB ...' user is able to transmit individual data packages. All reponses are placed into the sendbuffer. With the smallprotocol command 'Request for content of send buffer' (see page 10) the host can read out the sendbuffer. This can be done per polling, alternativly pin 20 'SBUF' shows with LO-signal that data is ready to transmit.

							Responses of the EA eDIPTFT43-A						
lo	d	num			data		Remarks						
						а	utomatic responses (placed into sendbuffer)						
ESC	Α	1	code				Response from the analog touch panel when a key/switch is pressed. code = down or up code of the key/switch. It is on transmitted if no touch macro with the number code is defined!						
ESC	В	2	no	value			When a bargraph is set by touch, the current value of the bar no is transmitted. Transmission of the bar balue must be activated (see the 'ESC A Q n1' command).						
ESC	F	2	no	value			When a instrument is set by touch, the current value of the instrument no is transmitted. Transmission of the intstrument must be activated (see the 'ESC A Q n1' command).						
ESC	P	1	value				After the input port is changed, the new 8-bit value is transmitted. The automatic port scan must be activated. See the 'E A n1' command. It is only transmitted when there is no corresponding port/bit macro defined!						
ESC	М	1	no				When a keystroke of the external matrix keyboard is detected, the newly pressed key number no is transmitted. Only transmitted if no corresponding matrix macro is defined!						
ESC	Н	5	type	xLO	xHI yLO	yHI	The following is transmitted in the case of a free touch area event: type=0 is release; type=1 is touch; type=2 is drag with free touch area at the coordinates xx1, yy1						
					Respon	se on	y when requested by command (placed into sendbuffer)						
ESC	В	2	no	value			After the 'ESC B S n1' command, the current value of the bar with the number no is transmitted.						
ESC	F	2	no	value			After the 'ESC I S n1' command, the current value of the instrument with the number no is transmitted.						
ESC	X	2	code	value			After the 'ESC A X' command, the current status (value=0 or 1) of the touch switch code is transmitted.						
ESC	G	2	no	code			After the 'ESC A G nR' command, the code of the active touch switch in the radio group no is sent.						
ESC	Υ	2	no	value			After the 'ESC Y R' command, the requested input port is transmitted. no=0: value is an 8-bit binary value of all 8 inputs. no=18: value is 0 or 1 depending on the status of the input no						
ESC	D	3	ch	LOval	Hlval		After the 'ESC V D ch' command, the requested voltage of channel ch=12 will be sent (value = 05000mV)						
ESC	W	num	ch	SC	aled ASCII string	J	After the 'ESC V S ch' command, the requested voltage of channel ch=12 will be set as scaled ASCII characters (length string = num-1).						
ESC	٧	num		vers	sion string		After the 'ESC S V' command, the version of the edip firmware is transmitted as a string e.g. "EA eDIPTFT43-A V1.0 Rev.A TP+"						
ESC	J	num		projec	tname string		After the 'ESC S J' command, the macro-projectname is transmitted. e.g. "init / delivery state"						
ESC	I	21	C	s, Y-dots, Version, Touchinfo, CRC-ROM, CRC-ROMsoll DF in KB,			after the 'ESC S I' command, internal information is sent by eDIP (16-Bit integer values LO-HI Byte)  Version: LO-Byte = version number Software; HI-Byte = Hardware revison letter touch  Touchinfo: LO-Byte = '- +' X direction detected; HI-Byte = '- +' Y direction detected  DFlen: number of user bytes in data flash memory (3 Bytes: LO-, MID- HI-Byte)						
						R	esponses without length specification (num)						
ESC	U	L	xx1	yy1	image data (G16-FORM		after the 'ESC UH' command, a hard copy is sent in G16-format.  xx1,yy1 = Start coordinates of the hard copy (upper left corner)						



### PRELOADED FONTS

As standard, there are 3 monospaced, 3 proportional character sets and 2 large digit fonts integrated. The proportional character sets (which have a narrow "I" and a wide "W", for example) look better and take up less space on the screen. Each character can be placed with **pixel accuracy**, and its height and width can be increased by a factor of 1 to 8. A text can be output left justified, right justified or centered. Rotation in 90° steps is possible. Macro programming permits further fonts to be integrated.

All kinds of fonts can be converted from True-Type Fonts by using using the LCD toolkit/eDIPTFTcompiler (the USB Evaluation Board EA 9777-2USB is required).

*) refer to web: http://www.lcd-module.c	com/pro	roducts/	edip.html
--	---------	----------	-----------

+ Lower Upper	\$0 (0)	\$1 (1)	\$2 (2)	\$3 (3)	\$4 (4)	\$5 (5)	\$6 (6)	\$7 (7)	\$8 (8)	\$9 (9)	\$A (10)	\$B (11)	\$C (12)	\$D (13)	\$E (14)	\$F (15)
\$20 (dez: 32)		·			5	8	8		C	)	×	+		-		7
\$30 (dez: 48)	0	1	2	3	4	5	6	7	В	9	:	;	<	=	>	?
\$40 (dez: 64)	0	A	В	c	D	E	F	G	н	I	J	К	L	н	n	0
\$50 (dez: 80)	P	a	R	s	т	U	V	н	×	γ	z	ι	ν.	1		_
\$60 (dez: 96)	,	a	ь		а	e	f	9	h	i	j	k	ι	н	n	
\$70 (dez: 112)	Р	q	r	,	t	u	v		×	9	ı	•	1	>	"	۵
\$80 (dez: 128)	E	ü			ä										ă	
\$90 (dez: 144)					ä					ŏ	ü				β	

Font 1: 4x6 monospaced

+ Lower Upper	\$0 (0)	\$1 (1)	\$2 (2)	\$3 (3)	\$4 (4)	\$5 (5)	\$6 (6)	\$7 (7)	\$8 (8)	\$9 (9)	\$A (10)	\$B (11)	\$C (12)	\$D (13)	\$E (14)	\$F (15)
\$20 (dez: 32)		į	**	#	\$	z	8.	•	C	)	*	+	,	-		7
\$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
\$40 (dez: 64)	6	A	В	С	D	Е	F	G	Н	I	J	ĸ	L	н	N	0
\$50 (dez: 80)	Р	Q	R	s	Т	U	V	н	X	Y	z	1	١	1	^	_
\$60 (dez: 96)	,	a	ь	С	d	е	f	9	h	i	j	k	ι	m	n	o
\$70 (dez: 112)	Р	q	r	s	ŧ	u	v	н	x	y	z	{	:	}	,,	۵
\$80 (dez: 128)	ε	ü	é	â	ä	à	å	Ç	é	ë	è	ï	i	ì	Ä	A
\$90 (dez: 144)	É	æ	Æ	ô	ö	ò	û	ù	ÿ	ö	Ü	¢	£	¥	В	f
\$A0 (dez: 160)	á	í	ó	ú	ñ	Ñ	<u>a</u>	0	į	-	-	X	У,	i	«	*
\$B0 (dez: 176)																
\$C0 (dez: 192)																
\$D0 (dez: 208)																
\$E0 (dez: 224)	α	ß	Γ	π	Σ	σ	μ	۳	Φ	θ	Ω	8	ø	ф	ε	n
\$F0 (dez: 240)	=	±	Σ	٤	ſ	J	÷	n	o	•		1	n	2	3	-

Font 3: 7x12 monospaced

<u> </u>		, I-												<u> </u>		
+ Lower Upper	\$0 (0)	\$1 (1)	\$2 (2)	\$3 (3)	\$4 (4)	\$5 (5)	\$6 (6)	\$7 (7)	\$8 (8)	\$9 (9)	\$A (10)	\$B (11)	\$C (12)	\$D (13)	\$E (14)	\$F (15)
\$20 (dez: 32)		ļ	"	#	\$	z	8.	,	(	>	*	+	,	-		/
\$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:	j	<	=	>	?
\$40 (dez: 64)	@	A	В	С	D	Ε	F	G	Н	I	J	К	L	М	N	0
\$50 (dez: 80)	Р	Q	R	s	Т	U	Ų	W	х	Υ	z	С	\	J	۸	_
\$60 (dez: 96)	·	а	b	c	d	е	f	9	h	i	j	k	1	m	n	0
\$70 (dez: 112)	ю	q	r	s	t	u	v	W	×	Э	z	{	1	)	~	٥
\$80 (dez: 128)	ε	ü	é	ā	ä	,a	á	ç	ē	ë	è	ï	î	ì	Ä	Á
\$90 (dez: 144)	É	æ	Æ	8	ö	٥,	ũ	ü	ij	ö	ü	¢	£	¥	β	f
\$A0 (dez: 160)	á	í	0	ű	ñ	z	<u>a</u>	2	ż	-	7	绉	lá	i	«	»
\$B0 (dez: 176)																
\$C0 (dez: 192)																
\$D0 (dez: 208)																
\$E0 (dez: 224)	α	β	г	π	Σ	σ	Д	т	Φ	θ	Ω	δ	0	ø	E	n
\$F0 (dez: 240)	=	±	Σ	<u> </u>	٦	J	÷	22	0	•	•	1	n	2	3	-

Font 2: 6x8 monospaced

+ Lower Upper	\$0 (0)	\$1 (1)	\$2 (2)	\$3 (3)	\$4 (4)	\$5 (5)	\$6 (6)	\$7 (7)	\$8 (8)	\$9 (9)	\$A (10)	\$B (11)	\$C (12)	\$D (13)	\$E (14)	\$F (15)
\$20 (dez: 32)		ļ		#	\$	%	&		(	)	*	+	,	-		7
\$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
\$40 (dez: 64)	@	Α	В	С	D	E	F	G	Н	ı	J	К	L	М	N	0
\$50 (dez: 80)	Р	Q	R	s	Т	U	٧	W	Х	Υ	Z	[	٨	]		_
\$60 (dez: 96)		a	Ь	С	d	е	f	g	h	i	j	k	1	m	n	0
\$70 (dez: 112)	Р	q	r	s	t	u	٧	w	×	y	z	{	ı	}	~	Δ
\$80 (dez: 128)	ε	ü	é	â	ä	, m	å	ç	ê	ë	è	ï	î	ì	Ä	Ã
\$90 (dez: 144)	É	æ	Æ	ô	ö	ò	û	ù	ij	ö	Ü					
\$A0 (dez: 160)	á	í	ó	ú	ñ	Ñ	ā	ō								
\$B0 (dez: 176)																
\$C0 (dez: 192)																
\$D0 (dez: 208)																
\$E0 (dez: 224)		В														
\$F0 (dez: 240)									0							

Font 4: GENEVA10 proportional



· 1																
+ Lower Upper	\$0 (0)	\$1 (1)	\$2 (2)	\$3 (3)	\$4 (4)	\$5 (5)	\$6 (6)	\$7 (7)	\$8 (8)	\$9 (9)	\$A (10)	\$B (11)	\$C (12)	\$D (13)	\$E (14)	\$F (15)
\$20 (dez: 32)		!	"	#	\$	%	8		(	)	*	+	,	_		7
\$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
\$40 (dez: 64)	@	A	В	С	D	Ε	F	G	Н	1	J	к	L	м	N	0
\$50 (dez: 80)	Р	Q	R	s	Т	U	U	Ш	X	Y	z	I	١	1	^	_
\$60 (dez: 96)	`	a	b	С	d	е	f	g	h	i	j	k	ı	m	n	o
\$70 (dez: 112)	р	q	r	s	t	u	υ	ш	н	y	z	{	ı	}	~	Δ
\$80 (dez: 128)	€	ü	é	â	ä	à	å	ç	ê	ë	è	ï	î	ì	Ä	Â
\$90 (dez: 144)	É	æ	Æ	ô	ö	ò	û	ù	ÿ	Ö	Ü					
\$A0 (dez: 160)	á	í	Ó	ú	ñ	Ñ	<u>a</u>	ō								
\$B0 (dez: 176)																
\$C0 (dez: 192)																
\$D0 (dez: 208)																
\$E0 (dez: 224)		ß														
\$F0 (dez: 240)									۰							

Font 5: CHICAGO14 proportional

+ Lower Upper	\$0 (0)	\$1 (1)	\$2 (2)	\$3 (3)	\$4 (4)	\$5 (5)	\$6 (6)	\$7 (7)	\$8 (8)	\$9 (9)	\$A (10)	\$B (11)	\$C (12)	\$D (13)	\$E (14)	\$F (15)
\$20 (dez: 32)		İ	**	#	\$	%	&	,	(	)	*	+	,	-		1
\$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
\$40 (dez: 64)	@	A	В	C	D	E	F	G	H	I	J	K	L	M	N	0
\$50 (dez: 80)	P	Q	R	S	T	U	٧	W	X	Y	Z		١	]	^	
\$60 (dez: 96)	6	a	b	C	d	е	f	g	h	i	j	k	I	m	n	0
\$70 (dez: 112)	р	q	r	S	t	u	٧	W	X	у	Z	{	!	}	~	Δ
\$80 (dez: 128)	€	ü	é	â	ä	à	å	Ç	ê	ë	è	ï	î	ì	Ä	Å
\$90 (dez: 144)	É	æ	Æ	Ô	Ö	Ò	û	ù	ÿ	Ö	Ü					
\$A0 (dez: 160)	á	í	Ó			Ñ										
\$B0 (dez: 176)																
\$C0 (dez: 192)																
\$D0 (dez: 208)																
\$E0 (dez: 224)		β														
\$F0 (dez: 240)									0							

Font 6: Swiss30 Bold proportional

+ Lower	\$0	\$1	\$2	\$3	\$4	\$5	\$6	\$7	\$8	\$9	\$A	\$B	\$C	\$D	\$E	\$F
Upper \	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
\$20 (dez: 32)												+		-		
\$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	:					

Font 7: big numbers BigZif50

+ Lower	\$0	\$1	\$2	\$3	\$4	\$5	\$6	\$7	\$8	\$9	\$A	\$B	\$C	\$D	\$E	\$F
Upper	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
\$20 (dez: 32)												+		-	•	
\$30 (dez: 48)	0	1	2	3	4	5	6	7	8	9	•					

Font 8: big numbers BigZif100



This hard copy shows all the fonts with which the product is shipped

### **ADDITIONAL FONTS**

Up to 256 fonts á 16 pages can be loaded into the internal DataFlash.



### **COMPILER OPTION** "WinFont:"

It is possible to raster TrueType-Fonts in different sizes witch can be used. A double-click to the fontname within the KitEditor opens the font selection box.

To simplify the use of fonts, there is the possibilty of a edit box. If you output a string with KitEditor (e.g. #ZL 5,5, "Hello"), you can perform a double click on the string to open it.

Now you can select the desired characters. This is mainly recommended



using cyrillic, asian or symbol fonts.

In that way, the KitEditor automatically places the right ASCII-Code. Alternativly you can use instead of the quotation mark curly brackets (e.g. +ZL 5,5, {48656C6C6F}).

### **COMPILER OPTION "Font:"**

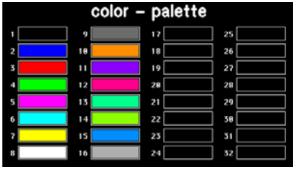
Following font formats can be used:

- FXT: Textfont as used by eDIP240/320 and KIT series
- G16: internal eDIPTFT format (with this format it is possible to user color fonts)

### 65,536 COLORS

EA eDIPTFT32-A is able to work with 65,536 colors for true-color pictures/icons and animations. For an easy use there exists a color palette with 32 entrys (16 colors are predefined after PowerOn). This color palette can be

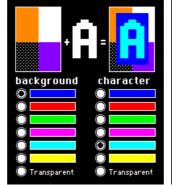
redefined at any time without Color R G В changing the content of the display (command: ESC FP no R G B). To use a color for text and graphic functions you set only a number between 1..32. 

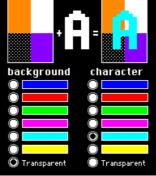


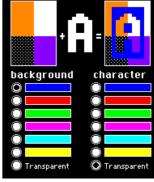
The dummy color number 255 means that the actually color is not changed e.g you want only to change the foreground- and not the background color. The color number 0=transparent is special and can be used for background of character e.g. that means that for placing a character no rectangular field will be deleted around the character itself. The sensless combination of transparent background and

111 111 transparent 143 255 foreground 175 | 175 | 175 is used to

invert all dots (=complementary). Two times inverted will end same as action was started (original drawing is restored).





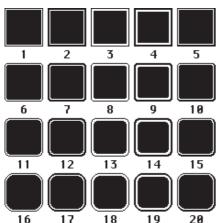


some examples to show the letter 'A' onto a fixed background



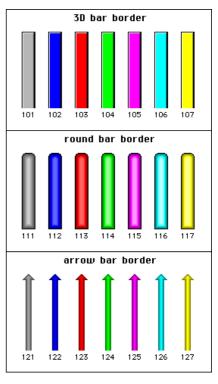
### BORDERS, KEY STYLES AND BARGRAPH

The eDIP is shipped with 20 predefined border (no:1..20) for the



commands draw box frame and draw touchkeys. There are also three special borders in various colors for using with bargraph commands (no:101..107, 111..117 and 121..127). All of them can be used in various sizes via coordinates. The frames 1..20 are split into 3 segments: the outer frame, inner frame and filling. Each segment will get an individual colour for normal and for selected state. This will give the user a field the individual part of the keywill

the opportunity, when touching a field, the individual part of the key will be inverted only.



### **FILL PATTERNS**

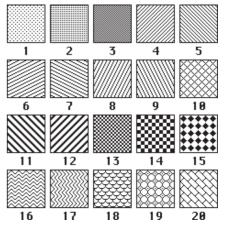
A pattern type can be set as a parameter with various commands. In this way, for example, rectangular areas and bar graphs can be filled with different patterns. The eDIP is shipped with 20 predefined fill patterns.

### Define own pattern:

With the LCD-tools it is possible to define new pattern (=bitmaps with exactly 8x8 dots).(Compileroption "Pattern:"). The foreground- and backgound color can be set for monochrome pattern (as the 20



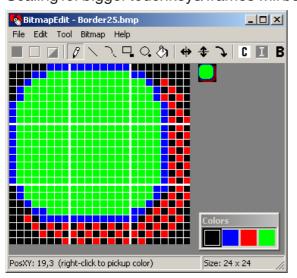
preloaded pattern) incl. transparency. It is also possible to define full colored pattern. With the LCD-tools some sample pattern has been installed (see folder 'Pattern').



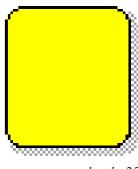
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### **DEFINE OWN BORDER**

With the LCD-tools it is possible to define new borders (Compileroption "Border:"). Each of these new border is a bitmap with exactly 24x24 dots (9 segments with 8x8 dots: 4x edge, 4x middle part, 1x filling). Scaling for bigger touchkeys/frames will be done by repetition of these 8x8 dot



segments. This makes it necessary to keep the 8x8 size in every case. If 4-color bitmaps are used (as the preloaded border 1..20) the color can be set individually (the first color is always transparent and is not used by the eDIP). It is also possible to define full colored border (as the preloaded border for bargraphs 101...127). With the



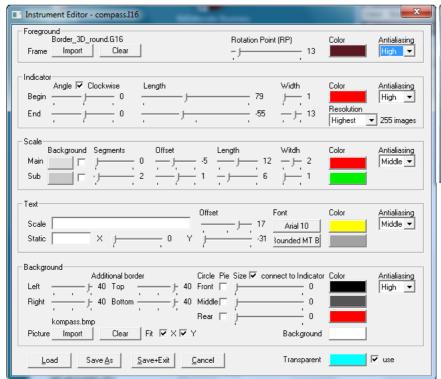
border25: 50x56 Dot size

LCD-tools some sample border has been installed (see folder 'Bitmaps\Color\Border').

### **ROTARY AND POINTER INSTRUMENTS (since V. 1.4)**

With the help of the LCD-Tools it is possible to include instruments (Compiler command: Instrument: 4, <instrument.i16>). Performing a double click in the KitEditor on the instrument file opens the instrument editor.

The instruments are supported by convinient commands ('ESC I..'). For example the instruments are connectable to an analog input. In addition they are configurable by touch.







### Some instrument examples:









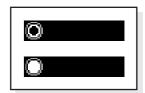


### **BUTTONS AS KEYS**

Apart from the border types, which are infinitely scalable, it is also possible to use bitmaps as touch keys or touch switches (Compilerotion "Button:").

A button always consists of two Bitmaps of equal size (one bitmap to display the touch key in its normal state and another for when it is pressed).

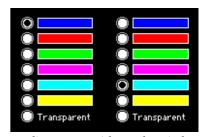
The active area of the touch key automatically results from the size of the button bitmaps.



RadioBlack75x15\_0.bmp RadioBlack75x15\_1.bmp

### **SWITCHES IN GROUPS (RADIO GROUPS)**

Touch switches change their status from *ON* to *OFF* or vice versa each time they are touched. Several touch switches can be included in a group ('ESC A R n1' command). If a touch switch in the group 'n1' is switched on, all the other touch switches in this group are automatically switched off. Only one switch is ever on (see table on page 16).



two radio groups with touch switches



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### CREATING INDIVIDUAL MACROS AND IMAGES

To create your own fonts, images, animations and macros you need the following:

- To connect the display to the PC, you need the EA 9777-2USB USB programmer, which is available as an accessory, or a self-built adapter with a MAX232 level converter (see the application example on p.5).
- ELECTRONIC ASSEMBLY LCD-Tools\*), which contains a kiteditor, bitmapeditor, ediptftcompiler, fonts, images, border, pattern and examples (for Windows PCs)
- A PC with an USB or serial COM interface

To define a sequence of commands as a macro, all the commands are written to a file on the PC (e.g. DEMO.KMC). You specify which character sets are to be integrated and which command sequences are to be in which macros.

If the macros are defined using the kit editor, you start the eDIPTFT compiler using F5. This creates a file called DEMO.DF. If an EA 9777-2USB programmer is also connected or the display is connected to the PC via a MAX232, this file is automatically burned in the display's data flash memory.

You can send the created macrofile \*.DF with any other system to the EA eDIPTFT43-A. All programming commands are inside this file, so you only need to send the content of the \*.df file (via RS232, SPI or I2C with smallprotocol in packets) to the EA eDIPTFT43-A.

### KIT-EDITOR HELP (ELECTRONIC ASSEMBLY LCD TOOLS)

At bottom from the KitEditor window in the statusline you can see a short description for the current command and the parameters. For more information press F1.





### **IMAGES**

To save transfer time via serial interface, it is possible to store up to 256 bitmaps á 16 pages into internal dataflash (Compileroption "Picture:").

Following image file-formats can be used:

- BMP: Windows Bitmap with 1-, 4-, 8-, 16-, 24-, 32-BIT colordepth incl. RLE.
- GIF: Graphics Interchange Format incl. optionally transparency
- JPG: JPEG Compressed Images
- TGA: TARGA Images with 8-, 16-, 24-, 32-BIT colordepth incl. RLE and transparency.
- PNG: Portable Network Graphics incl. colour map, gray scale and transparency
- G16: internal eDIPTFT format, incl. RLE and transparency

All pictures are converted into internal G16 format with RLE encoding (saves memory).

Too big pictures are resized proportional (Compileroption "MaxSize:").

It is also possible to reduce the colordepth (Compileroption "MaxColorDepth:").

One color can be defined as transparent (Compileroption "MakeTransparent:")

The internal pictures can be used with the command "ESC U I" via serial interface or from a macro. The foreground- and backgound color can be set for monochrome pictures incl. transparency.

### **ANIMATIONS**

It is possible to store up to 256 animations á 16 pages into internal dataflash. (Compileroption "Animation:").

Following image file-formats can be used:

- GIF: animated GIF (only identically transparent areas, transparency can be switched off).
- G16: internal animated eDIPTFT format
- two or more single bitmaps (BMP, GIF, JPG, TGA, PNG, G16) e.g. two bitmaps for blinking Note that max. 4 animations (animationprocesses) can run at the same time. The animations are self-running pictures, but you can use the animations manually too.

The foreground- and backgound color can be set for monochrome animations.

### **PATTERN**

Patterns are used to fill a box, a bargraph or to draw a line. It is possible to store up to 256 pattern á 16 pages into internal dataflash (Compileroption "Pattern:").

Each bitmap (BMP, GIF, JPG, TGA, PNG, G16) with a size of 8x8 dots can be imported as a pattern. The foreground- and backgound color can be set for monochrome pattern incl. transparency.

### **BORDER / BARGRAPH**

A border can be scaled and is used for rectangles, bargraphs and touch keys/switches. It is possible to store up to 256 border á 16 pages into internal dataflash (Compileroption "Border:")

Each bitmap (BMP, GIF, JPG, TGA, PNG, G16) with a size of 24x24 dots can be imported as a border. The transparency of GIF, TGA and G16 bitmaps is used by the EA eDIP.

It is possible to change the colors for 4-color borders, the first color ist always transparent and is not used by the EA eDIP. When used for a touch key/switch a second border can be loaded witch will be used if the touch key/ switch is pressed.

### **IMAGES AS TOUCHKEYS (BUTTONS)**

It is possible to store up to 256 touchkeys/buttons á 16 pages into internal dataflash. (Compileroption "Button:").

A button consists of one or two images with the same size (BMP, GIF, JPG, TGA, PNG, G16).

The transparency of GIF,TGA, PNG and G16 bitmaps is used by the EA eDIP and should be identical. The first bitmap is used when the touch key/switch is released and the second bitmap is used if the touch key/ switch is pressed.



### **MACROS**

Single or multiple command sequences can be grouped together in macros and stored in the data flash memory. You can then start them by using the *Run macro* commands. There are different types of macro (compiler directive marked in green letters):

### Normal macros Macro:

These are started by means of an 'ESC MN xx' command via the serial interface or from another macro. A series of macros occurring one after the other can be called cyclically (movie, hourglass, multi-page help text). These automatic macros continue to be processed until either a command is received via the interface or a touch macro with a corresponding return code is activated.

### Touch macros (1 to 255) TouchMacro:

Started when you touch/release a touch field (only in versions with a touch panel - TP) or issue an 'ESC MT xx' command.

### Bit macros BitMacro:

will be started by a single line IN 1..8 (bit) will change or by command 'ESC MB xx'.

Bit- Macro 1..8 are good for falling edge and Bit Macro 9..16 are good for rising edge at input 1..8. It is possible to change the assignment between Bitmacro and intput with command 'ESC YD n1 n2 n3' (since firmware V1.1, see page 17).

### Port macros PortMacro:

These are started when voltage (binary) is applied to IN 1..8 or by command 'ESC MP xx'.

### Matrix macros MatrixMacro:

Matrix Macro 1..64: start when keypressed or by command 'ESC MX xx'.

Matrix Macro 0: start after release of key or by command.

It is possible to change the assignment between keynumber and Matrixmacro with command 'ESC YX n1 n2 n3' (since firmware V1.1, see page 17)

### Analogue Macros AnalogMacro:

will start whenever voltage changes or limit exceeds or by command 'ESC MV xx'. See table at the right: It is possible to change the assignment between analoguemacrofunction and Analoguemacronumber with command 'ESC VM n1 n2' (since firmware V1.1, see page 15)

### Process macros ProcessMacro:

automatic start at fixed periode (0.1s up to 25s) or by command 'ESC MC xx'. Up to 4 individual process may be defined by command 'ESC MD ..'. These Process Makro will never be stopped by other commands or activities.

		Analogue Macro
Macr	o No.	Macro starts at
AIN	AIN	Macro starts at
0	10	every change of input voltage
1	11	falling input voltage
2	12	rising input voltage
3	13	below lower limit
4	14	above lower limit
5	15	below upper limit
6	16	above upper limit
7	17	outside of both limits
8	18	inside of both limits
9	19	lower than other channel
	•	

### Power-on macro PowerOnMacro:

Started after power-on. You can switch off the cursor and define an opening screen, for example.

### Reset macro Reset Macro:

Started after an external reset (low level at pin 5).

Watchdog macro Watchdog Macro:

Started after a fault/error (e.g. failure).

Brown-out macro BrownoutMacro:

Started after a voltage drop under 4.6V.

**Important:** If a continuous loop is programmed in a power-on, reset, watchdog or brown-out macro, the display can no longer be addressed. In this case, the execution of the power-on macro must be suppressed. You do this by wiring DPOM:

- PowerOff connect pin 13 (DPOM) to GND
- PowerOn open pin 13 (DPOM) again.



### MACRO PAGES (MULTILINGUAL CAPABILITY)

There are 16 complete macro sets available as well as the internal images and fonts. By simply switching the active macro page (ESC M K n1), for example, up to 16 different languages can thus be supported.

If a macro/picture is defined in the kit editor, a page number can be specified in square brackets after the macro/picture number.

If a macro/image is not defined in the currently set page [1] to [15], this macro/picture is automatically taken from page [0]. Thus, not all macros and images have to be stored separately for each language when they are identical in each language.

```
PICTURE: 100[0] <BIER.BMP>
PICTURE: 100[1] <BEER.BMP>
PICTURE: 100[2] <BIRRA.BMP>
                         ; SAME AS "MACRO: 2"
MACRO: 2[0]
       #FZ 3,1
       #ZL 25,0 "DEUTSCH "
       #UI 0,20, 100
MACRO: 2[1]
                        ; ENGLISH
       #FZ 3,1
       #ZL 25,0 "ENGLISH "
       #UI 0,20, 100
MACRO: 2[2]
                        ; ITALIAN
       #FZ 3,1
       #ZL 25,0 "ITALIAN "
       #UI 0,20, 100
```

If there is only the need of handling strings differently, stringtables might be used. Depending on the active macropage (ESC M K n1) the desired string is called. Please check the following example:

```
STRINGCODE=$01

STRING: 100[0] "HALLO WELT "
STRING: 100[1] "HELLO WORLD "
STRING: 100[2] "CIAO A TUTTI "

MACRO: 1

#ST StringCode
#ZL 10,5, StringCode, 100
```

### WRITE PROTECTION FOR MACRO PROGRAMMING AND FONTS

A LO level at pin 19 (WP) prevents the macros, images and fonts in the data flash memory from being overwritten inadvertently (so it is highly recommended!).



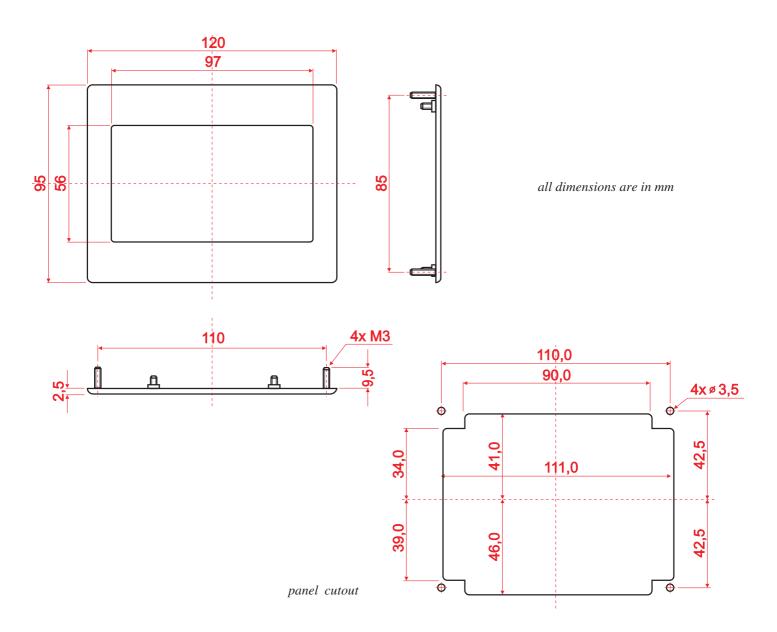
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### **SPEZIFICATION AND CHARACTERISTICS**

	Charac	teristics			
Value	Condition	min.	typ.	max.	Unit
Operating Temperature		-20		+70	°C
Storage Temperature		-30		+80	°C
Storage Humidity	< 40°C			90	%RH
Operating Voltage		4.9	5.0	5.1	V
Input Low Voltage		-0.5		0.3*VDD	V
Input High Voltage	Pin Reset only	0.9*VDD		VDD+0.5	V
Input High Voltage	except Reset	0.6*VDD		VDD+0.5	V
Input Leakage Current	Pin MOSI only			1	uA
Input Pull-up Resistor		20		50	kOhms
Output Low Voltage				0.7	V
Output High Voltage		4.2			V
Dei alata a a (calaita)	w./o. Touch		500		cd/m²
Brightness (white)	with Touch		410		cd/m²
Output Current				20	mA
Davier Circulu	Backlight 100%		180		mA
Power Supply	Backlight off		80		mA



### **MOUNTING BEZEL EA 0FP481-43SW**



### NOTES ON HANDLING AND OPERATION

- The module can be destroyed by polarity reversal or overvoltage of the power supply; overvoltage, reverse polarity or static discharge at the inputs; or short-circuiting of the outputs.
- It is essential that the power supply is switched off before the module is disconnected. All inputs must also be deenergized.
- The display and touch screen are made of plastic and must not come into contact with hard objects. The surfaces can be cleaned using a soft cloth without solvents.
- The module is designed exclusively for use in buildings. Additional measures have to be taken if it is to be used outdoors. The maximum temperature range of -20 to +70°C must not be exceeded. If used in a damp environment, the module may malfunction or fail. The display must be protected from direct sunshine.





